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ECHINODORUS IN THE AMERICAN TROPICS

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I. INTRODUCTION

THIS study includes all the species of *Echinodorus* in the New World north of the Tropic of Capricorn; all are tropical with the exception of one that is confined to the United States. The temperate zone of South America has been excluded because of the several species described from Argentina, Uruguay and southern Brazil, that are not well represented in the available collections.²

The first extensive treatment of *Echinodorus* as a genus distinguished from *Alisma* and *Sagittaria* was by Micheli, in DeCandolle, *Monographiae Phanerogamarum* vol. 3: 44–60. 1881. It was a splendid work; the descriptions of species were not only long and detailed, but covered just the points that seem most diagnostic today. Further reference to Micheli's acumen will be made in the discussion of *E. andrieuxi*. Micheli, to an extent not followed by later workers, made good use of the pellucid markings present in the leaves of many species. These can be seen only with transmitted light. The present writer uses a binocular microscope placed over a hole in the table-top, with an electric light in the drawer below.

¹ Professor Fassett died September 16, 1954. For a tribute to him and an account of some of his botanical activities see RHODORA 56: 233–242. 1954. Eds.

² Material has been borrowed from the United States National Museum, the New York Botanical Garden, the Chicago Natural History Museum, the Gray Herbarium, the Academy of Natural Sciences of Philadelphia, and the Missouri Botanical Garden. Locations of cited specimens are indicated by the abbreviations recommended in the recently published *Index Herbariorum*. Maps 1–3, 7, and 13c are on a base map copyrighted by McKnight & McKnight, Bloomington, Illinois.

Unfortunately, many of the collections cited by Micheli are not represented in the herbaria available to the present writer. A few fragments of types turn up, but most of them consist of a bud or two and are of no value; some have mature nutlets and are very helpful. There are a few of Micheli's names that I have not been able to account for.

II. SUBGENERA AND SECTIONS

The dwarf plants passing as *Echinodorus tenellus*, or *E. parvulus*, have been the basis of the genus *Helianthium*.³ The segregation seems to have been on the following set of differences: *Echinodorus*: (1) style apical; (2) fruit-heads echinate; (3) achenes flat; (4) achenes beaked; (5) stamens 12–30, or rarely fewer; (6) carpels numerous. *Helianthium*: (1) style not apical; (2) fruit-heads not echinate; (3) achenes very turgid; (4) achenes beakless or obscurely beaked; (5) stamens 6 or 9; (6) carpels relatively few.

Another character not listed in the literature appears in the anthers; they are versatile in *Echinodorus* (*sensu stricto*) and basifixed in *Helianthium*.

Some of these characters do not hold, and those that do hold seem insufficient for generic segregation. The style is nearly apical in two hitherto undescribed South American representatives of *Helianthium* (Figs. 71 and 72), and strongly lateral in *Echinodorus cordifolius* (*E. radicans*)—see Fig. 77 in Gray's Manual, ed. 8, or figure on page 96, vol. 1, Britton and Brown's Illustrated Flora, ed. 2; fruiting heads are scarcely echinate in *E. cordifolius*. Two species of the *Helianthium* group have beaked achenes (Figs. 71 and 72), as does *Echinodorus nymphaeifolius*, which is also put into *Helianthium* on the basis of its small number of carpels and stamens. The dozen or so carpels and 6 or 9 stamens with basifixed anthers in *Helianthium*, contrasted with about 100 carpels and usually 12–30 stamens with versatile anthers in *Echinodorus* (*sensu stricto*), appear to be consistent, but scarcely sufficient for generic separation.

The genus *Echinodorus* may be subdivided as follows:

a. Carpels many in a dense head; stamens 12–30; anthers versatile.

Subgenus 1. *Echinodorus*.

³ Britton, Man. ed. 2, 54. 1905; Small, N. Am. Fl. 17, pt. 1: 45. 1909; Britton & Brown, Ill. Fl. ed. 2, 1: 95. 1913.

- a. Carpels 20 or fewer in a loose head; stamens 6 or 9; anthers basifixed.
Subgenus 2. *Helianthium*.
- b. Ribs of achenes crested; blades of emersed leaves cordate; inflorescence compound. Section *Nymphaeifolii*.
- b. Ribs of achenes not crested; blades of all leaves linear-lanceolate to elliptic; inflorescence of one or few whorls. Section *Tenelli*.

Subgenus ECHINODORUS. *Echinodorus* Britton, Man. ed. 2: 54. 1905; Small, N. Am. Fl. 17, pt. 1: 45. 1909; Small, Man. S. E. Fl. 21. 1933. Type species, *Alisma rostratum* Nutt.

Subgenus **Helianthium** (Engelm.) stat. nov. *Helianthium* Engelm. in Britton, l.c.; Small l.c.

Section **Nymphaeifolii**, sect. nov., carpellorum costis alatis; laminis foliorum cordatis. Type species *Alisma nymphaeifolium* Griseb.

Section **Tenelli**, sect. nov., carpellorum costis non alatis; laminis foliorum lanceolatis vel ellipticis. Type species *Alisma tenellum* Mart.

The nutlets of Sect. *Tenelli* frequently have what may be termed a beaklet; it is a small umbo, of the same texture as the rest of the pericarp, directly below the style (Fig. 67) or sometimes some distance below it (Fig. 70). Sometimes the style appears to come directly from the beaklet (Fig. 69). When a longer beak is present, it seems to be of styler origin (Figs. 71, 72).

III. TAXONOMIC TREATMENT

- a. Carpels many in a dense head; stamens 12–30; anthers versatile.
Subgenus *Echinodorus*.
- b. Sepals 12–20-nerved, thin, withering, not accrescent, reflexed or loosely ascending in fruit; pellucid markings of leaves, if present, not reticulate.
- c. Blades of leaves cordate or truncate at base (Figs. 1–13) (elliptic on some dwarfed individuals, Figs. 8 and 9, and linear on some submersed leaves); petiole not winged.
- d. Flowers on pedicels several times as long as the fruiting heads.
- e. Blades with pellucid lines or dots (pellucid markings occasionally obscure or absent, especially on dwarfed or submersed membranous leaves); leaves glabrous except in species no. 8.
- f. Nutlets about $\frac{2}{3}$ as broad as long, the dorsal margin rounded at summit (Fig. 22), and facial glands nearly round; little-known plant of Mexico. 1. *E. virgatus*.
- f. Nutlet twice as long as broad, the dorsal margin sloping downward; facial glands mostly longer than wide (Figs. 23 and 51).
- g. Sepals with papillose ridges; scape erect when young but soon procumbent; nutlet with summit of keel often crested and beak ascending (Figs. 23, 24). 2. *E. cordifolius*.
- g. Sepals with smooth veins; scape erect at maturity; nutlet with keel entire and beak erect or nearly so (Figs. 25–34).

- h.* Leaves glabrous, with pellucid lines often several mm. long (Fig. 55); facial glands of nutlet often entering the base of the long (0.5–2 mm.) beak (Figs. 25, 29)
3. *E. Berteroi*.
- h.* Leaves with stellate hairs on lower surface near base of blade; pellucid dots abundant (Fig. 56) but lines absent or rare (except in varieties (Figs. 57, 58) in Paraguay and Argentina); facial glands of nutlet rounded at both ends and scarcely approaching to within one gland-length of the short (0.2 mm.) and stout beak (Figs. 30, 31)
4. *E. grandiflorus*.
- e.* Leaves without pellucid markings, with stellate hairs on lower surface near base of blade and summit of petiole (hairs often rubbing off and leaving papilla-like bases). (Fig. 11).
- i.* Inflorescence erect, often compound, with pedicels reaching 3 cm. in length.....5. *E. muricatus*.
- i.* Scape creeping, simple, sometimes 2 m. long, rooting at nodes and sometimes proliferous, with erect pedicels sometimes reaching 7 cm. in length.....6. *E. fluitans*.
- d.* Flowers nearly sessile.....7. *E. bracteatus*.
- c.* Blades tapered or subtruncate at base (Figs. 14–21), petioles mostly winged.
- j.* Petioles not winged (Fig. 13); little-known plant of Cuba.
8. *E. ovalis*.
- j.* Petioles winged (Figs. 14–21).
- k.* Leaves veined from the base of the blade or sometimes slightly pseudopenninerved (Figs. 14, 15, 17–20); flowers pedicelled.
- l.* Inflorescence racemose; pedicels 2–4-angled, scarcely ribbed or fluted; body of nutlet 2–2.5 times as long as wide (Figs. 41–43), with beak (0.5)–0.8–1 mm. long, the face with one gland (rarely 2)
9. *E. Andrieuxi*.
- l.* Inflorescence paniculate on larger plants; pedicels (when dry) with about 10 winged angles; body of nutlet more than half as wide as long (Figs. 48, 49), with short stout beak and no glands
10. *E. paniculatus*.
- k.* Leaves pseudopenninerved (Figs. 16, 21); flowers sessile or nearly so.
- m.* Leaves many times as long as wide, acuminate (Fig. 21); rachis of inflorescence with green wings about 2 mm. wide; fruit glandless (Fig. 50).....11. *E. trialatus*.
- m.* Leaves about 3 times as long as wide, acute (Fig. 16); rachis of inflorescence not winged; fruit with several facial glands (Fig. 51).....12. *E. Grisebachii*.
- b.* Sepals about 30-nerved, thick and brittle, enlarging in fruit to cover the fruiting head; pellucid markings reticulate (Fig. 64)....13. *E. tunicatus*.
- a.* Carpels 20 or fewer in a loose head; stamens 6 or 9; anthers basifixed.
Subgenus *Helianthium*.
- n.* Ribs of nutlet crested (Fig. 53); blades of emersed leaves ovate and deeply cordate.....Section *Nymphaeifolii*.
14. *E. nymphaeifolius*.
- n.* Ribs of nutlets not crested (Figs. 66–72); blades of all leaves linear-lanceolate to elliptic (Figs. 73–76).....Section *Tenelli*.

- o.* Summit of nutlet rounded above the beaklet (Figs. 66–70); stylar beak nearly absent or up to 0.4 mm. long; anthers 0.2–1.0 mm. long.
- p.* Facial ribs 3 on each side (Figs. 66, 67, 70) or suppressed (Fig. 68) 15. *E. tenellus*.
- p.* Facial ribs 4 on each side (Fig. 69) 16. *E. isthmicus*.
- o.* Summit of nutlet horizontal or sloping downward from the beaklet (Figs. 71, 72); stylar beak 0.6–0.8 mm. long; anther 0.4–0.6 mm. long.
- q.* Nutlet with 4 distinct facial ribs (Fig. 72) . . . 17. *E. quadricostatus*.
- q.* Nutlet with facial ribs nearly or quite obsolete (Fig. 71). 18. *E. magdalenensis*.

1. ECHINODORUS VIRGATUS (Hook. & Arn.) Micheli in DC. Monogr. Phan. **3**: 54. 1881; Buch. in Engler, Pflanzenr. **4**, pt. 15: 32. 1903; Small, N. Am. Fl. **17**, pt. 1: 47. 1909. *Alisma virgata* Hook. & Arn., Bot. Beech. Voy. 311. 1839.

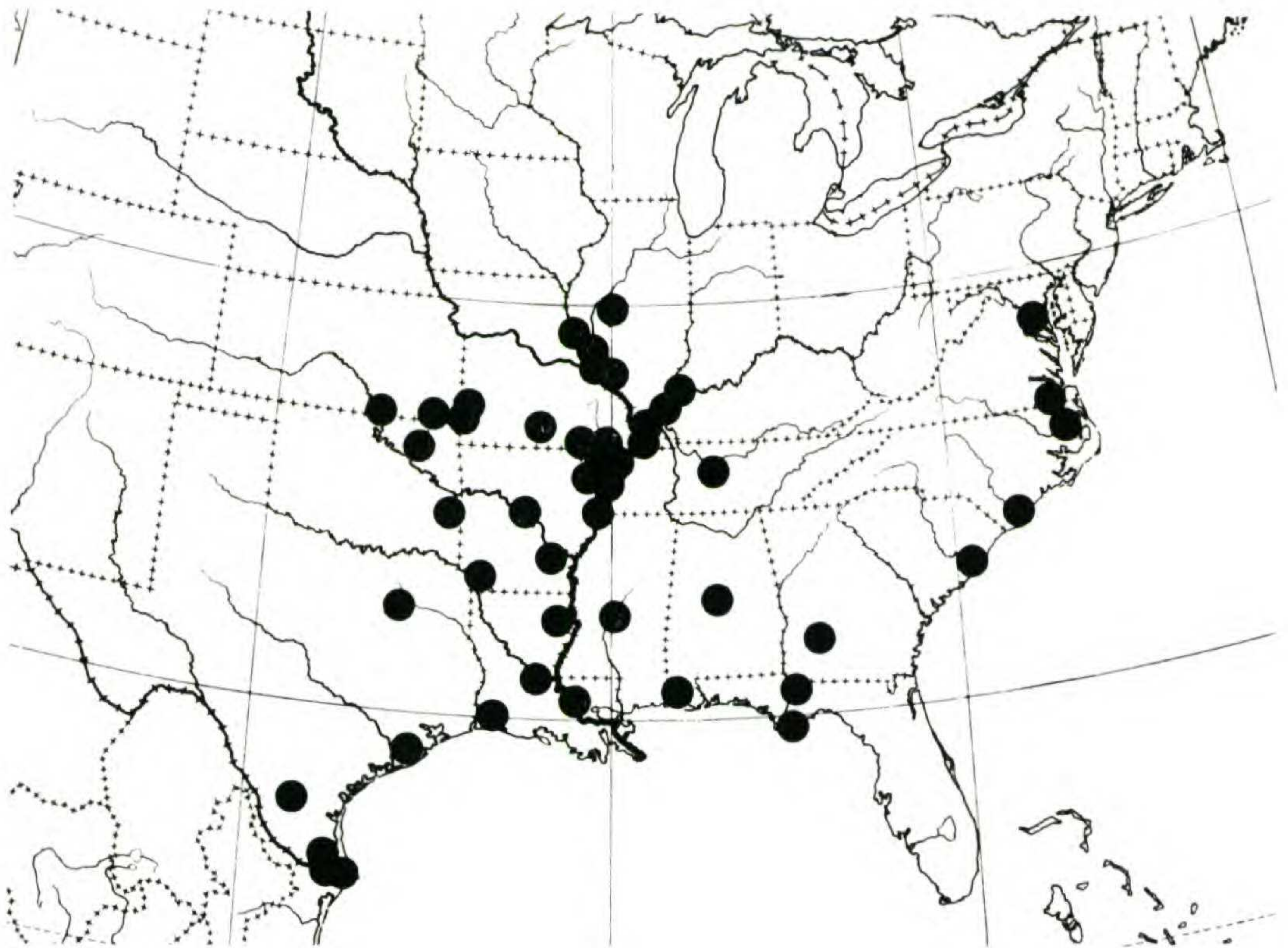
Tepic, Mexico.

Our Fig. 22 shows the very distinctive nutlet, from a fragment of the TYPE (MO). "Mexico" is the only locality given in the original description, but on page 275 is the statement, "When no habitat is mentioned, the specimens are understood to have been collected at Tepic." Fig. 1 is traced from a drawing of the TYPE (NY); I have not seen an actual leaf to examine the pellucid lines, which Micheli describes as being elongate. The drawing of the type shows about 10 flowers at a node, on pedicels 0.5–1 cm. long.

2. ECHINODORUS CORDIFOLIUS (L.) Griseb. in Goett. Abh. **7**: 257, repr. 109. 1857, at least as to Linnean basionym, not as to other synonyms; Fernald, Rhodora **49**: 107. 1947, and in Gray's Manual, ed. 8. 85. 1950. *Alisma cordifolia* L. Sp. Pl. 343. 1753. *Sagittaria radicans* Nutt., Trans. Am. Phil. Soc. **5**: 159. 1837. *Echinodorus radicans* Engelm. in Gray, Man. 460. 1848, and ed. 2. 438. 1856; Robinson & Fernald in Gray's Manual, ed. 7. 84. 1908; Fassett, Man. Aquat. Pl. 93. 1940; Muenscher, Aquat. Pl. U.S. 84. 1944.

In transferring the Linnean *Alisma cordifolia* to *Echinodorus*, Grisebach confused it with another species, perhaps the Brazilian *E. macrophyllus* (Kunth) Micheli. Grisebach also refers to Vell. Ic. Fl. Flumin. 10, t. 31. 1827, which illustrates an erect compound inflorescence quite unlike that of *E. cordifolius* as here treated. But, as Fernald demonstrates, the name rests on *Alisma cordifolia* L. from Virginia.

Leaves erect, long-petioled, the blade broadly ovate, shallowly cordate or truncate at base and rounded at apex, 6–20 cm. long, 4–8 cm. wide; pellucid markings nearly round or elongate, seldom exceeding 1 mm. but rarely reaching 3 mm. in length, mostly 1 mm. or more apart (Fig. 54),



Map 1. *Echinodorus cordifolius*.

very rarely obscure or lacking; scape at first erect, soon prostrate, usually with long-triangular bracts but sometimes with small leaves at the nodes; flowers 5–15 at a node, on pedicels 2–6 cm. long; sepals with papillose ridges; nutlets about 2.5 mm. long and 0.8–1.2 mm. wide, with ascending beaks only about 0.2 mm. long (rarely –0.8 mm.) so that the head of nutlets appears smooth to the naked eye; nutlet with an often irregularly crested dorsal keel (Figs. 23, 24); facial ribs 3–4, often abruptly bent, the two toward the dorsal keel most strongly winged toward the summit; glands 1 or 2, short and rounded, not approaching to within one gland-length of the base of the beak.

Atlantic Coastal Plain from southern Texas to northern Florida and the District of Columbia; up the Mississippi Valley to central Tennessee, southern Indiana, central Illinois, northeastern and southwestern Missouri, southeastern Kansas, eastern Oklahoma and northeastern Texas (Map 1). **District of Columbia:** flats of Potomac at Chain Bridge, 1 August 1900, *Steele* (NY). **Virginia:** Franklin, Southampton Co., 22–29 July 1893, *Heller 1026* (PH, MO, F, US, NY). **North Carolina:** Wilmington, 2 August 1900, *Williamson* (NY, PH); Edenton, Chowan Co., 10 July 1938, *Godfrey 5353* (US). **South Carolina:** mud bank, Santee River, near Jamestown, Berkeley Co., 27 June 1939, *Godfrey & Tryon 118* (MO, US, NY); St. Johns, *Porcher* (NY). **Georgia:** margin of pool in Flint River bottoms, Dooly Co., 3 September 1900, *Harper 564* (US, NY). **Florida:**

Aspalaga, October 1897, *Chapman* (mo); Apalachicola, *Chapman* (NY). **Illinois:** Menard Co., 1861, *Bebb* (F); Menard Co., August 1864, *Hall* (F, PH); lakes by Cahokia, 23 August 1878, *Eggert* (mo); Bluffs Lake, St. Clair Co., 27 July 1878, *Eggert* (mo); swamps opposite St. Louis, August 1863, *Engelmann* (mo); Flat Lake, Calhoun Co., 19 October 1920, *Metcalf* 1117 (US). **Indiana:** in the dried up bottom of the Pitcher pond about 6 mi. northwest of Mt. Vernon, Posey Co., 8 October 1916, *Deam* 22303 (NY). **Kentucky:** in water at Swan Pond, Wicliffe, 18 August 1923, *McFarland & Anderson* 168 (mo, US). **Tennessee:** Nashville, August, *Gattinger* 2741 (mo, US, NY). **Alabama:** Prattville, 22 July 1874, *Smith* (US); exposed open places, Mobile, 30 May 1884, *Mohr* (US). **Mississippi:** Jackson, 19 July 1925, *Cook* (US); creek bottom, Natchez Trace Parkway, 24 June 1948, *McDougall* 1683 (US). **Missouri:** low wet woods, near Torch, Ripley Co., 12 July 1933, *Palmer & Steyermark* 41598 (mo); Little Creve Coeur Lake, 15 September 1891, *Douglass* (mo); Poplar Bluffs, Butler Co., September 1897, *Russell* (mo); Kennett, 18 September 1893, *Bush* (mo); wet mud around margin of Goose Lake, Papinsville, Bates Co., 1 October 1938, *Steyermark* 9986 (F, mo); low woods bordering Stulz Lake along Marmaton River, Nevada, Vernon Co., 29 September 1938, *Steyermark* 9800 (F, mo); ditches along road, Quilin, Butler Co., 27 May 1939, *Steyermark* 26640 (F); Kings Lake, Lincoln Co., 7 August 1927, *Kellogg* 816 (mo); Pike Co., 1860, *Peck* (F); Pence Lake, Vernon Co., 1 August 1919, *McAtee* 3042 (US). **Arkansas:** moist soil in bottoms, Little Rock, 7 June 1885, *Haase* (PH); Bayou Bartholomew, Lincoln Co., Yorktown, 10 September 1936, *Demaree* 13760 (mo, US); Fulton, 18 September 1900, *Bush* 931 (mo); low swampy woods, Corning, Clay Co., 24 June 1914, *Palmer* 6056 (mo, F); sandy bogs along Yellow Creek, near McNab, Hempstead Co., 27 October 1924, *Palmer* 26722 (mo); Dryden, Craighead Co., 22 August 1913, *Emig* 55 (mo); wet spring ditches, Lake City, Craighead, 25 June 1929, *Demaree* 6940 (F, US); Lake Waponoca, Crittenden Co., 17 November 1910, *McAtee* 1884 (US). **Louisiana:** single plant at spring in pine barrens, Alexandria, 27 May 1899, *Ball* 482 (mo); Hamburg, 13 September 1912, *McAtee* 2215 (US); Baton Rouge, July 1914, *Griffins* (NY); swamp east of Tallulah, 29 June 1946, *Fassett* 26692 (WIS). **Kansas:** Cowley Co., 1898, *White* (mo); Wilson Co., 1895, *Haller* 983 (mo, US, NY). **Oklahoma:** Verdigris River, 21 August 1895, *Blankinship* (mo, US); E. Dartlesville, Washington Co., 31 August 1927, *Stratton* 505 (mo); Heavener, 20 June 1936, *de Gruchy* 119 (NY). **Texas:** swamps, Dallas, 5 June 1902, *Reverchon* 4043 (mo, NY); Santa Maria, 1889, *Nealley* 505 (F); water's edge, Riviera, Brooks Co., 9 April 1933, *Clover* 825 (NY); Houston, October 1842, *Lindheimer* (mo); San Antonio, Bexar Co., 30 June 1911, *Clemens* 124 (mo); Los Fresnas, 10 July 1923, *Runyon* 446 (US); in marshy pond, Tarrant Co., 10 August 1925, *Ruth* 1349 (US).

3. *ECHINODORUS Berteroi* (Spreng.) n. comb. *Alisma Berteroi* Spreng., Syst. 2: 163. 1825. *A. Berteroanum* Balbis in R. & S., Syst. Veg. 7: 1605. 1830; Kunth, Enum. 3: 152. 1841. *A. cordifolius* Kunth, Enum. 3: 152.

1841, not L. *A. Sprenglii* Kunth, Enum. **3**: 152. 1841. *Echinodorus cordifolius* β . *Berteroanus* Griseb. in Goett. Abh. **7**: 257, reprint 109. 1857. *E. rostratus* Engelm., Gray's Man. 460. 1848.

Emerald leaves erect, long-petioled, the largest (reaching perhaps 20 cm. in length) broadly oval and shallowly cordate (Fig. 2) or broadly ovate (Fig. 3), the smaller becoming narrower in proportion, down to the small elliptic or lanceolate leaves on dwarfed plants (Figs. 4, 5, 7); pellucid lines usually very clear, the longest commonly reaching about 2.5 mm. in length (a maximum of 11 mm. observed), extending nearly from veinlet to veinlet (Fig. 55), rarely locally absent; submersed leaves, when present, usually ribbon-like and membranous; scape erect, the lower branches compound; head of nutlets appearing echinate due to the spreading beaks; nutlets (Figs. 25–29) broadly keeled, with 2 winged ribs alternating with 3 non-winged ribs; facial gland commonly single, close to the beak, usually with an attenuate tip entering its base.

West Indies and southern Mexico, north to Ohio, Illinois, Missouri, Kansas, Texas and California (Maps 2a & 2b). Reported from Central America in Gray's Manual, ed. 8, and in North American Flora, probably erroneously.

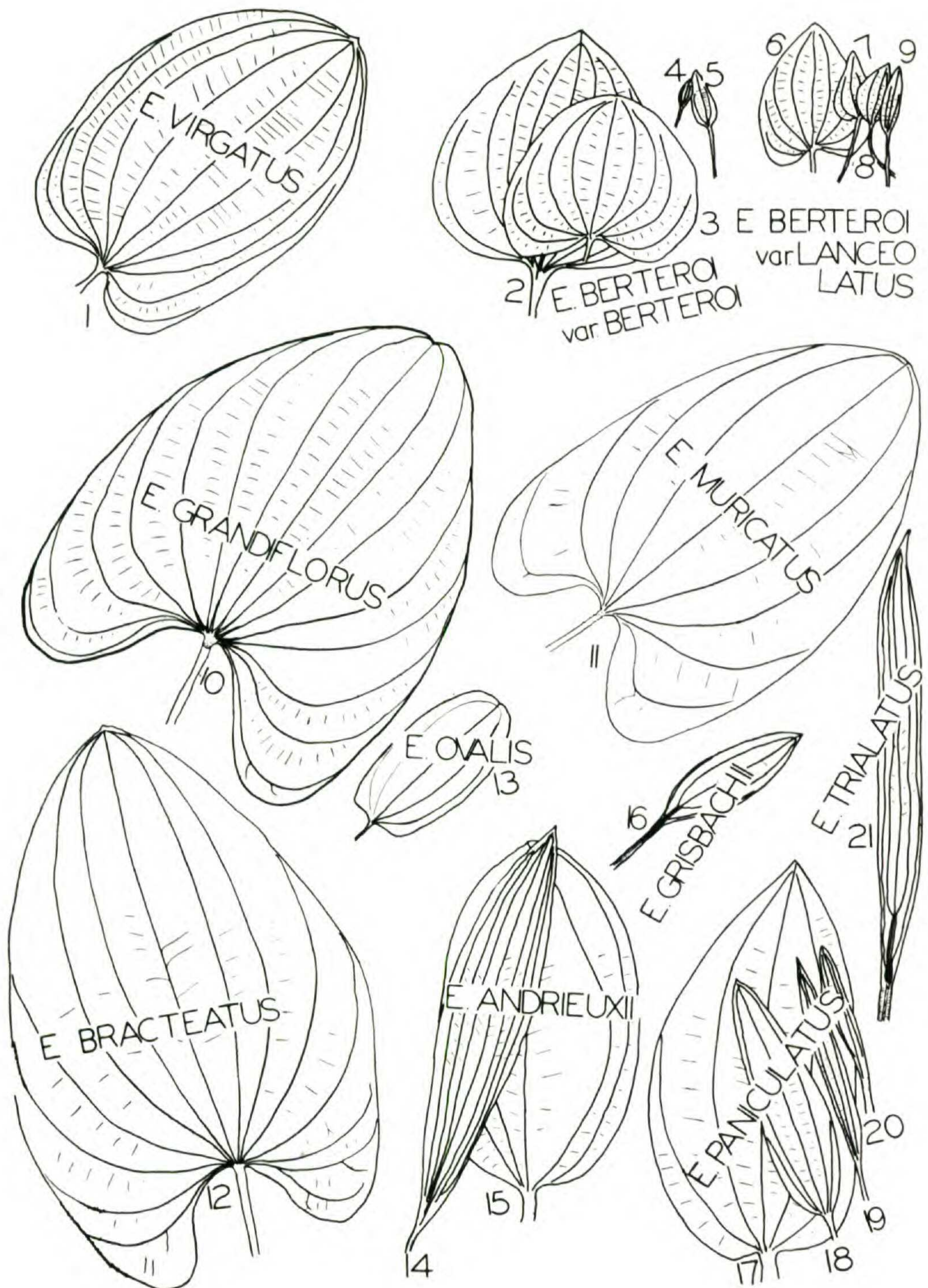
The positive identification of *Alisma cordifolia* as the creeping plant also known as *Echinodorus radicans* (no. 2 of the present treatment) was followed by the adoption of the name *E. rostratus* (Nutt.) Engelm. for the erect species sometimes called *E. cordifolius* (Fernald, Rhodora **49**: 108. 1947). But there are at least two older names for *E. rostratus*, both based on material from Guadeloupe. The description of *Alisma Berteroi* was brief: "A. foliis oblongis utrinque attenuatis 3 nervis, scapo 3 gono, capsulis cuspidatis." Only the last two words are helpful, referring to the beaked fruit (Figs. 25–29). The leaves were certainly from a dwarfed plant, like our Figs. 5 & 9. The description of *A. Berteroanum* is ample and clear, and the leaves are stated to be 5- or 7-nerved. Kunth, substituting the name *A. Sprenglii* for *A. Berteroi*, suggested that it was but a form of *A. Berteroanum*. The more ample material now at our disposal demonstrates the polymorphism of the leaves of this species (Figs. 2–9) as quite sufficient to include both *A. Berteroi* and *A. Berteroanum*.

The northern and southern phases of this species differ mainly in the length of beak on the nutlet; much material in the region of overlap, in Texas, Oklahoma and California, is intermediate.

- a. Beak of nutlet 1.2–2 mm. long, $\frac{1}{2}$ – $\frac{2}{3}$ as long as the body (Figs. 25–27); anthers 0.8–1.2 mm. long. 3a. *E. Berteroi* var. *Berteroi*.
- a. Beak of nutlet 0.5–0.8 (–1) mm. long, $\frac{1}{3}$ – $\frac{1}{2}$ as long as the body (Figs. 28, 29); anthers 0.5–0.8 mm. long. 3b. *E. Berteroi* var. *lanceolatus*.

3a. E. BERTEROI (Spreng.) Fassett, var. BERTEROI. *Alisma Berteroi* Spreng., l.c. From southern California, Kansas, Oklahoma and Texas, where many individuals are more or less intermediate with the northern variety, var. *Berteroi* ranges southward to central Mexico and northern Yucatan. I have not seen material from the mainland of Florida, but it is on the Keys. It appears to be local in Cuba, but abundant throughout the Bahamas, Hispaniola, Puerto Rico and the Lesser Antilles. Just as it approaches but is not known to reach continental Florida, so it is represented by several collections from Curaçao but not from continental South America (Map 2a).

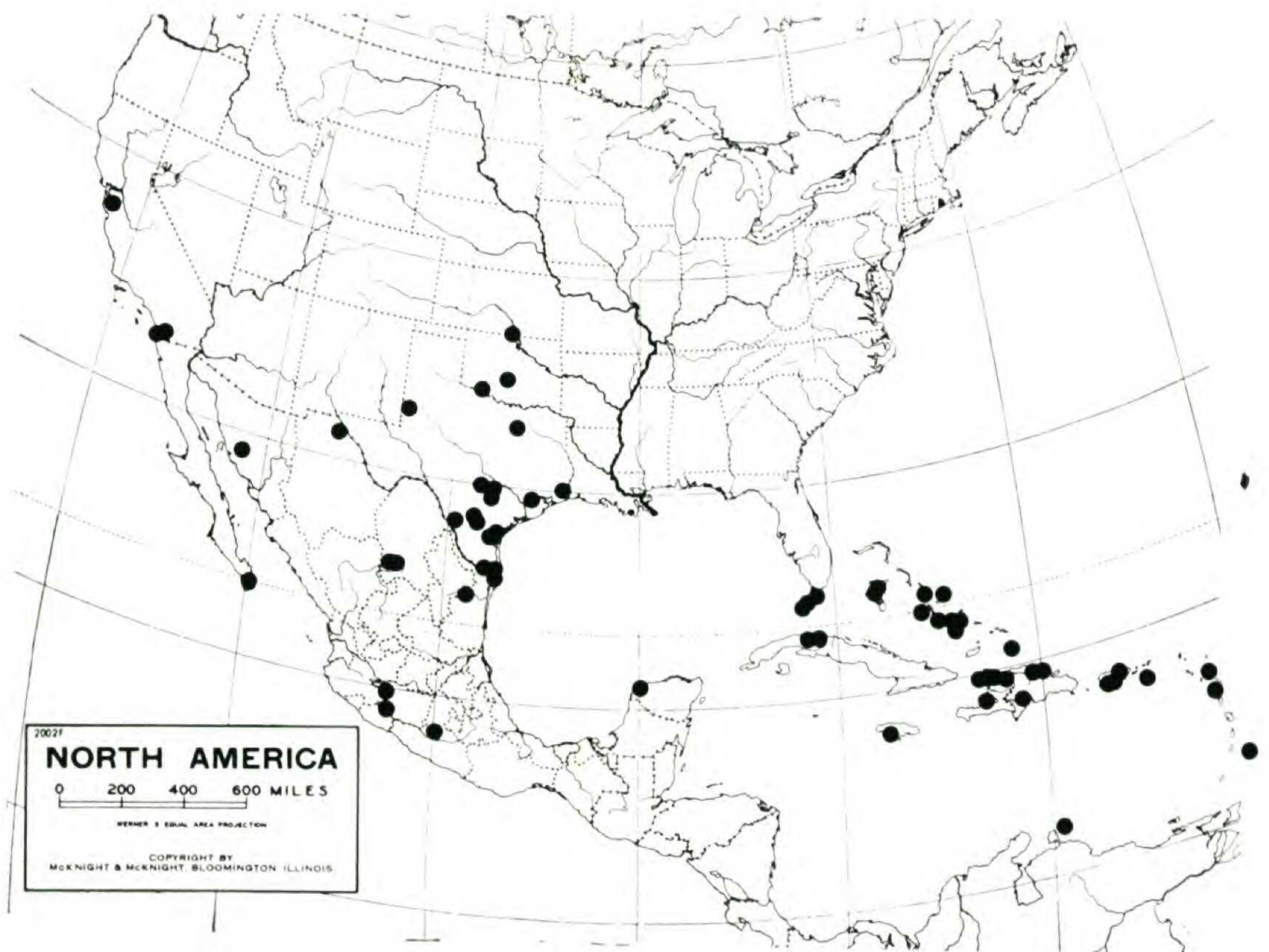
Florida: Key West, June 1839, *Ritch* (US); dry ponds, Lower Matecumbe, 4 February 1892, *Simpson 434* (US, NY); Key West, *Blodgett* (NY). **Kansas:** Cowley Co., 1898, *White* (MO, US). **Oklahoma:** creek bed, covered with water to a depth of about 4", also on wet banks, 2 mi. sw. of Cache, 26 May 1936, *de Gruchy 13* (MO); pond, 6 mi. n. of Oklahoma City, 30 May 1939, *Waterfall 1182* (NY). **Texas:** on banks of Lake Como, Tarrant Co., 12 October 1919, *Ruth 203* (PH, F); dry sink in prairie, Caldwell Co., 13 July 1943, *Barkley 13135* (US); in paludosis prope las Nuces, April 1834, *Berlander 2422* (US); San Antonio, 2 October 1900, *Bush 1222* (MO); San Antonio, 23 June 1911, *Clemens 120* (MO); water's edge, La Joya, Hidalgo Co., 14 March 1933, *Clover 639* (NY); land on which water has stood near old river channel, Brownsville, Cameron Co., 1-5 August 1921, *Ferris & Duncan 3178* (MO, NY); water-hole, Corpus Christi, September 1884, *Havard* (US); Comanche Spring, New Braunfels, August 1850, *Lindheimer 1233* (F, NY); swamp, Pleasanton Rd. 9 mi. s. of San Antonio, 9 July 1931, *Metz 198* (NY); shallow pools, Silsbee, Hardin Co., 13 June 1916, *Palmer 10174* (MO); shallow pools, Uvalde, 14 October 1916, *Palmer 11031a* (MO); Lubbock, *Reed 3169* (US); Curry Creek, Blanco Co., 1884, *Reverchon 1772* (MO); Lavaca River, Jackson Co., 27 August 1941, *Tharp 15* (MO); Demmit Co., 24 June 1941, *Tharp* (MO); Brownsville, 26 October 1927, *Rose & Russell 24243* (US); Austin, August 1921, *Schulz 906* (NY); San Marcos, Spring, 1897, *Stanfield* (NY). **California:** San Diego Co., August 1897, *Allen* (NY); Lakeside, San Diego Co., 23 (or 30?) June 1906, *Brandeggee* (MO, F); lake margin, Laguna Cañon, Laguna Beach region, 26 July 1916, *Crawford* (MO); Sweetwater, July 1884, *Orcutt* (MO, F); drying lake bed, Stanford University lake, Santa Clara Co., 14 July 1946, *Rose 46218* (MO). **Baja California:** along stream below Santiago, 6 May 1931, *Wiggins 5663* (US, NY, GH); **Sonora:** Canyon Estrella, Dist. Alamos, 1 October 1933, *Gentry 421M* (F); Agua Caliente, Alamos, 10 November 1933, *Gentry 896M* (US). **Chihuahua:** water hole near Guadalupe, 11-12 October 1852, *Thurber 805* (GH). **Coahuila:** Torreon, 13-20 October 1898, *Palmer 466* (F, GH, MO, US, NY). **Tamaulipas:** Matamoros, 2 September 1939, *LeSueur 53* (F); El Mulato, 16 August 1930, *Bartlett 10984* (F, GH). **Michoacan:** swamps, Zamora, 5000 ft. alt., 21 May 1901, *Pringle 8484* (F, GH, PH, MO, US, NY); LaHuerta, District of Apatzingan, 29-30 December 1890, *Maury 5310* (NY). **Guerro:** Iguala, 25 October 1900, *Pringle 9277* (GH, US). **Yucatan:** Progreso, 5 March 1899, *Millspaugh 1692bis* (F, US); in fresh water pool, Progreso,



11-15 August 1932, *Steere 3093* (NY). **Bahamas:** Long Cay, 7-17 December 1905, *Brace 4081* (F, US, NY); Pompey Bay, Acklin's Island, 21 December to 6 January 1906, *Brace 4424* (F, NY); water holes, Stopper Hill, Crooked Island, 9-23 January 1906, *Brace 4829* (F); sink holes near Georgetown, Great Exuma, 22-28 February 1905, *Britton & Millspaugh*

3104 (F, GH, US, NY); Cat Island, 1–6 March 1907, *Britton & Millspaugh* 5798 (F); Watling's Island, Graham's Harbor to Cockburn Town, 15 March 1907, *Britton & Millspaugh* 6206 (F, NY); Grand Turk Island, The Wells and vicinity, 16 March 1911, *Millspaugh & Millspaugh* 9338 (F); black loam, swampy, Fresh Creek settlement, Andros, 31 March 1905, *Wight* 256 (F, GH, NY). **Cuba:** *Wright*, without locality (GH); Barreras, Playa de Tarara, Habana, 28 August 1930, *Léon* 14661 (GH); Playa de Marianao, Prov. Habana, 22 February 1910, *Britton & Wilson* 4556 (NY); little lagoon on a serpentine hill, Guyana, Havana, 1 June 1911, *Léon* 2585 (NY); in water, serpentine hill, Cuabal de Figueras, ne. of Canasí, Matauzas, 31 May 1928, *Leon* 13381 (NY). **Jamaica:** in shaded swamps, Salt Ponds, 27 December 1915, *Harris* 13312 (F, GH, NY, US). **Haiti:** shallow pond and swamp area between Terrier Rouge and Fort Liberté, northeastern alluvial plain, 26 June 1941, *Bartlett* 17472 (GH, US); moist place, Presqu'île do Nord-Ouest, Port-de-Paix, Etang-Portalus, 13 March 1928, *Ekman* 9683 (US); among cat-tails, common, Etang Saumatre, 7 April 1920, *Leonard* 3516 (GH, NY, US); muddy bank of stream, scarce, La Source, Pikmi, Gonave Island, 7 July 1920, *Leonard* 5188 (US, NY); Ennery, Dept. de l'Artibonite, alt. 325–900 m., 3 February 1926, *Leonard* 9449 (US); in bed of Mole River, Mole St. Nicolas, 13–19 February 1929, *Leonard & Leonard* 13139 (US, GH, NY); muddy roadside, west of Trois Rivières, Port de Paix, 12 May 1929, *Leonard & Leonard* 15630 (US); sea level, Bayeux, near Port Margot, 3 August 1903, *Nash* 60 (F, NY). **Dominican Republic:** Peñon, Prov. Barahona, September 1911, *Fuertes* 1132 (F, GH, NY, US); Sto. Domingo in paludosis ad Rio Muñoz, 100 m., 15 June 1887, *Eggers* 2477 (NY); sitio húmedo, cerca de la playa, Cerca de Gaspar Hernandez, 5 April 1950, *Jimenez* 1958 (US). **Puerto Rico:** river swamp, Coamo Reservoir, 8 February 1922, *Britton*, *Britton & Brown* 5949 (NY); along stream, Coamo Springs, 23 March 1906, *Britton & Cowell* 1340 (NY); Guayanilla, 10 March 1913, *Britton & Shafer* 1793 (NY, US); borders of Lake Guanica, Guanica, 11–12 March 1913, *Britton & Shafer* 1868 (NY, US); in paludosis, Coamo, 21 December 1885, *Sintenis* 3200 (GH, US); Guanica, in arenosis litoralibus ad lagunas, 20 January 1886, *Sintenis* 3375 (US, MO); Guanica, in litore ad la Plata, 24 February 1886, *Sintenis* 3844 (F, GH, PH, NY, US); Palo Seco, 3 February 1916, *Stevenson* 3837 (US); marsh, Guanica Lagoon, 17 March 1937,

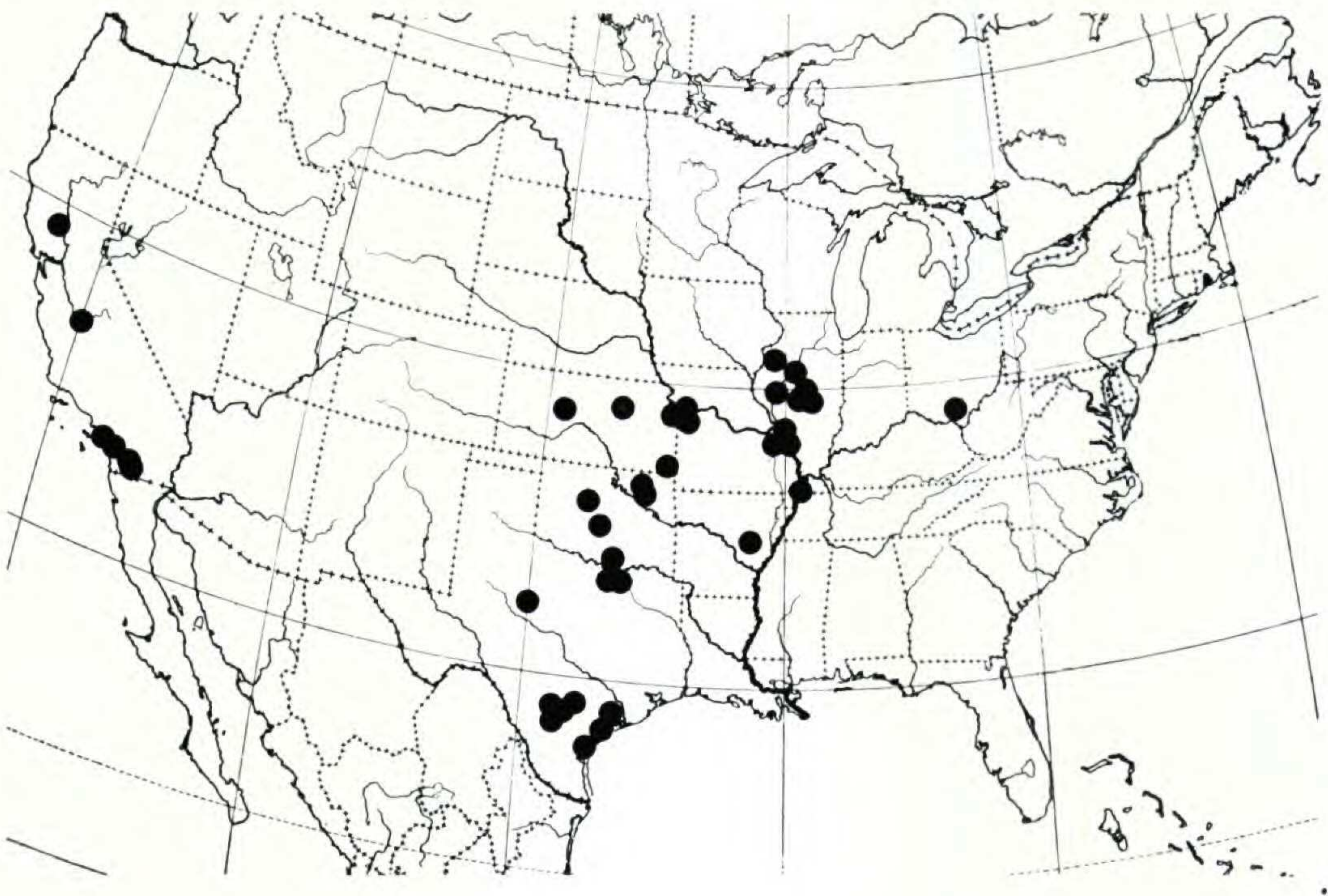
FIG. 1–21. LEAVES OF SUBGENUS *ECHINODORUS* ($\times \frac{1}{4}$). FIG. 1: *E. virgatus*. Mexico, Beechey (from drawing of type in NY). FIG. 2–5. *E. Berteroi* var. *Berteroi*. 2: Puerto Rico, Sintenis 3200 (US). 3: Guadeloupe, Duss 3652 (US). 4, 5: Haiti, Bartlett 17472 (US). FIG. 6–9: *E. Berteroi* var. *lanceolatus*. 6: Illinois, Engelmann (MO). 7–9: Illinois, Engelmann (Type of *E. rostratus* var. *lanceolatus*, in MO). FIG. 10. *E. grandiflorus* var. *grandiflorus*, Panama, Woodson & Schery 754 (US). FIG. 11. *E. muricatus*, Brazil, Tate 61 (NY). FIG. 12. *E. bracteatus* var. *bracteatus*, Ecuador, Hitchcock 20084 (US). FIG. 13. *E. ovalis*, Cuba, Wright (US). FIG. 14, 15. *E. Andrieuxi*. 14: Mexico, Pringle 8256 (US). 15: Mexico, Mexia 1065 (NY). FIG. 16. *E. Grisebachii*, Cuba, Wright 4198 (isotype in US). FIG. 17–20. *E. paniculatus* var. *paniculatus*. 17: Venezuela, Fernandez 71 (US). FIG. 18: Brazil, Krukoff 2030 (US). 19: Brazil, Glaziou 14288 (US). 20: Venezuela, Chardon 26 (US). FIG. 21. *E. trialatus*, Colombia, Cuatrecasas 5283 (type in US)



Map 2a. *Echinodorus Berteroi* var. *Berteroi*.

Vélez (NY). **Virgin Islands:** King's Hill gut, St. Croix, 17 March 1897, *Ricksecker* 255 (F, MO, US); Catherine's Rest, 14 February 1896, *Ricksecker* 275 (F, GH, MO, NY, US). **Antigua:** in small colonies in estate ponds and in sluggish streams, Elliotts, 15 February 1938, *Box* 1370 (US); ponds and the lower reaches of sluggish streams, Judges, 1 November 1937, *Box* 1243 (US). **Guadeloupe:** Capesterre Marie-Galante, 1895, *Duss* 3652 (F, GH, MO, NY, PH, US); Grande-Terre, 5 March 1937, *Stelé* 1555 (US); Gosier, March 1937, *Questel* 4584 (US). **Barbados:** Ealin Grove pond, 13 August 1906, *Dash* 163 (US, NY). **Curacao:** Water hole, Mt. Pleasant, 20–27 March, 1913, *Britton & Shafer* 3115 (F, NY, US).

3b. *E. BERTEROI* (Spreng.) Fassett, var. ***lanceolatus*** (Engelm.) n. comb. *E. rostratus* var. *lanceolatus* Engelm. ex Wats. & Coult. in Gray's Man. ed. 6. 556. 1891. *E. cordifolius* var. *lanceolatus* Mackenzie & Bush, Man. Fl. Jackson Co., Missouri 10. 1902; Robinson & Fernald in Gray's Man. ed. 7. 84. 1908. *E. cordifolius* f. *lanceolatus* Fernald, *Rhodora* **38**: 73. 1936. *E. rostratus* f. *lanceolatus* Fernald, *Rhodora* **49**: 108. 1947, and in Gray's Man. ed. 8. 85. 1950. *Alisma rostratum* Nutt., Trans. Am. Phil. Soc. **5**: 159. 1837. *Echinodorus rostratus* Engelm., Gray's Man. 460. 1848; Wats. & Coult. in Gray's Man. ed. 6. 556. 1891; Fernald, *Rhodora* **49**: 108. 1947, and in Gray's Man. ed. 8. 85. 1950. *E. cordifolius* Mackenzie & Bush, Man. Fl. Jackson Co., Missouri 10. 1902;

Map 2b. *Echinodorus Berteroi* var. *lanceolatus*.

Britton & Brown, Ill. Fl. 1: 86. 1896; Small, Fl. S.E. U.S. 42. 1903; Robinson & Fernald in Gray's Man. ed. 7. 84. 1908; Small, N. Am. Fl. 17, pt. 1: 47. 1909; Small, Man. S.E. Fl. 22. 1933; Fassett, Man. Aquat. Pl. 93. 1940; Muenscher, Aquat. Pl. U.S. 82. 1944.

Centering in the lower Missouri and central Mississippi River valleys, north to central Illinois and southern South Dakota, thence southward to intergrade with var. *Berteroi* in Texas and in outlying districts westward in California (Map 2b).

Ohio: pond $\frac{1}{2}$ mi. west of Vause Station, Liberty Twp., Ross Co., 23 July 1936, *Bartley & Pontius* 91 (NY). **Illinois:** Oquawka, Henderson Co., 29 July 1892, *Patterson* (F); Peoria Co., *Stewart* (F); Peoria, *Brendell* (F, US); Beardstown, August 1928, *Turner* 784 (F); Menard Co., 1861, *Bebb* (F); Menard Co., various collections of *Hall* (F, MO, US, NY); margin of ponds, American Bottom, September 1846, *Engelmann* (MO)—marked "lanceolat." by Engelmann, and to be taken as TYPE of *E. rostratus* var. *lanceolatus* Engelm.); Mitchell, Madison Co., 7 September 1927, *Steyermark* 871 (MO); Mason Co., 23 August 1845, *Mead* (MO); St. Clair Co., 12 June 1879, *Eggert* (F, MO); East St. Louis, 9 August 1897, *Eggert* (F, US, NY). **Iowa:** mud flats, infrequent, Fremont Co., 15 August 1898, *Fitzpatrick* (F, MO, NY); Hamburg, *Hitchcock* (MO, NY); California Junction, Harrison Co., October 1904, *Shimek* (US) & 25 August 1908, *Shimek* (MO). **Missouri:** Independence, 22 August 1882, *Bush* 10 (MO); Atherton, Jackson Co., 9 July 1896, *Bush* 437 (MO, US); Clay Co., 9 August 1895, *Bush* 598 (MO); St. Louis, August 1845 & August 1848, *Engelmann* (NY); Sheffield,

28 September 1895, *Mackenzie 556* (MO, NY); Wolf Island, Mississippi Co., 11 July 1933, *Palmer & Steyermark 41508-A* (MO). **South Dakota:** Yankton, September 1892, *Thornber* (MO); water hole, Vermillion, Clay Co., 18 August 1927, *Over 17422* (US). **Nebraska:** Omaha, August 1899, *Williamson* (PH); in ditch along road, flooded early in growing season, Holt Co., 20 miles south of O'Neill, 20 August 1941, *Tolstead 41464* (MO); Dodge Co., 18 July 1883, *Pepoon* (MO). **Kansas:** Claflin, 19 August 1929, *Benke 5099* (F); ponds, Crawford Co., 1896, *Hitchcock 853* (MO, US, NY); Ellis Co., 28 July 1885, *Kellerman* (US, MO); Manhattan, 29 July 1892, *Clothier* (US); Argentine, 23 September 1895, *Mackenzie* (NY). **Oklahoma:** Verdigris, 5 October 1894, *Bush 605* (NY, MO); shallow water, Fish Hatchery Pond, Medicine Park, 28 May 1936, *de Gruchy 52* (MO, NY); Sapulpa, 1 October 1894, *Bush 606* (MO); pond west of Daugherty, Murray Co., 2 June 1945, *Waterfall 6044* (MO); wet sandy shore of Crystal Lake, 2 miles north of Norman, Cleveland Co., 9 October 1936, *Hopkins 775* (MO); Cache Creek, 2 miles southwest of Cache, 26 May 1936, *de Gruchy 13* (NY); Durant fish hatchery, Durant, 29 May 1936, *de Gruchy 66* (NY). **Texas:** bases submerged in water of small pool near Barton Springs Creek, 23 July 1943, *Barkley 15* (MO, NY); common in ponds, Columbia, 14 October 1900, *Bush 1497* (MO); Dallas, 2 July 1872, *Hall 622* (F, MO, US, NY); Dallas Co., 1926, *Hynes 15* (MO); Comanche Spring, New Braunfels, September 1849, *Lindheimer 1232* (MO, PH, US); Corpus Christi, May 1913, *Orcutt 5800* (MO); ditches, Wharton, Wharton Co., 24 September 1914, *Palmer 6630* (F, MO); shallow pools, Brazoria, Brazoria Co., 3 May 1916, *Palmer 9666* (MO); Lake Como, Tarrant Co., 7 October 1920, *Ruth 203* (F, MO); Camp Barkley, Taylor Co., 1943, *Tolstead 7346* (MO). **California:** Ramona, October 1903, *Brandeggee* (US); Lakeside, San Diego Co., 30 June 1906, *Brandeggee* (US); Laguna Canyon, 26 July 1916, *Crawford* (US); Tranquillity, Fresno Co., 10 August 1937, *Hoover 2656* (US); Laguna Cañon, Orange Co., alt. 350 ft., 3 September 1918, *Johnston 2151* (US); Sweetwater, July 1884, *Orcutt 321* (US); shores of Elsinore Lake, San Diego Co., 3 November 1891, *Parish 2246* (F, MO); Laguna Lakes, 15 July 1919, *Streit* (PH); Moreno Dam, San Diego Co., alt. 3200 ft., 7 October 1938, *Wiggins 9204* (US).

There are two sheets that would extend the range considerably, but whose authenticity is to be doubted. One is labelled Delaware: borders of ponds, Canterbury, July, *Wm. M. Canby* (NY). Mr. Bayard Long, of the Academy of Natural Sciences of Philadelphia, writes me that this is without doubt a case of mixing of labels, and that *E. rostratus* (*E. Berteroi*) does not to his knowledge appear anywhere in the region. Canby did collect *E. parvulus* at Canterbury and his material appears in several herbaria. Actually, the label on the sheet in question bears the name *Echinodorus parvulus*; "*parvulus*" has been crossed out and "*cordifolius*" written above it, in a hand other than the

original collector's. The other sheet is labelled Minnesota: borders of ponds in mud, Fort Snelling, July 1888, *Dr. W. H. Forwood* (US). Dr. Gerald B. Ownbey of the University of Minnesota writes me that none of the many collectors in the Fort Snelling area have taken this species, unknown north of southern Iowa. He quotes Dr. John Moore who thinks Dr. Forwood was an army doctor who did some traveling on the plains. In view of these facts, and of the extensive collecting that has been done in this part of Minnesota and southward along the Mississippi River, it seems likely that Dr. Forwood's plant did not come from Fort Snelling.

Although the northern phase of *E. Berteroi*, like the southern, generally has leaves of the broadly cordate type (Fig. 6), the earliest name applied in the varietal category is that of Engelman, applied to dwarfed plants with lanceolate leaves (Figs. 8, 9 are from the type). And so we have another case where a slightly atypical plant, named and distinguished from the common phase, becomes the TYPE of the common phase from which it was originally distinguished. The type of *E. rostratus* var. *lanceolatus* was only a small and narrow-leaved plant such as one might pick up on almost any pond-shore where the species abounds.

Alisma rostratum Nutt. was described from "the ponds of the Verdigris river of Arkansas" (now in Oklahoma). The type is at the Academy of Natural Sciences of Philadelphia, and through the kindness of Mr. Walter M. Benner I have before me two achenes from this collection. Fig. 28 illustrates one of them; while it belongs with the northern short-beaked variety, it is in the region of overlap and shows a little more tendency toward the long-beaked variety than do plants from regions farther north.

Introgression between *E. Berteroi* and *E. cordifolius* is suggested by several individuals. **Missouri:** Stoddard Co.; woods bordering Swan Pond, T 28 N, R 10 E, sect. 35, 4 mi. south of Advance, 28 August 1948, *Steyermark 66159* (F). Leaves with pellucid lines 2.5 mm. long, and achenes with a suberect beak and alternate ribs winged, as in *E. Berteroi*; scape creeping, sepals papillose, and glands of the achene well below the beak and rounded as in *E. cordifolius*. **Illinois:** lakes by Cahokia, 23 August 1878, *Eggert* (PH). Leaves with pellucid lines reaching 3 mm. as in *E. Berteroi*; scape creeping as in *E. cordifolius*; achenes short-

beaked as in *E. cordifolius* but sometimes with facial glands tapered into the beak as in *E. Berteroi*; papillose condition of sepals intermediate. **Texas:** Lavaca Run, Jackson Co., 27 August 1941, *Tharp 15* (mo), and Gillespie Co., *Jermy* (mo). Pellucid lines closely spaced and reaching 4 mm. in length, and sepals scarcely papillose, as in *E. Berteroi*; scape creeping as in *E. cordifolius*.

4. ECHINODORUS GRANDIFLORUS (Cham. & Schlecht.) Micheli in DC., Monogr. Phan. **3**: 57. 1881. *Alisma grandiflorum* Cham. & Schlecht., Linnaea **2**: 152. 1827; Kunth, Enum. **3**: 153. 1841; R. & S., Syst. Veg. **7**: 1606. 1830; Seub. in Mart., Fl. Bras. **3**, pt. 1: 108. 1847. *Alisma floribundum* Seub. in Mart., Fl. Bras. **3**, pt. 1: 109. 1847. *Echinodorus floribundus* Seub. in Warm., Symb. fasc. **13**: 113. 1872. *E. grandiflorus* α *floribundus* Micheli in DC., Monogr. Phan. **3**: 58. 1881. *E. grandiflorus* var. *floribundus* Hauman, Anal. Mus. Nac. Buenos Aires **27**: 311. 1915, in part at least. *E. grandiflorus* var. *longiscapus* (Arech.) Hauman, l.c., in part. *E. muricatus* Woodson & Schery, Fl. Panama, Ann. Mo. Bot. Gard. **30**: 101. 1943, probably not *E. macrophyllus* β . *muricatus* Griseb.

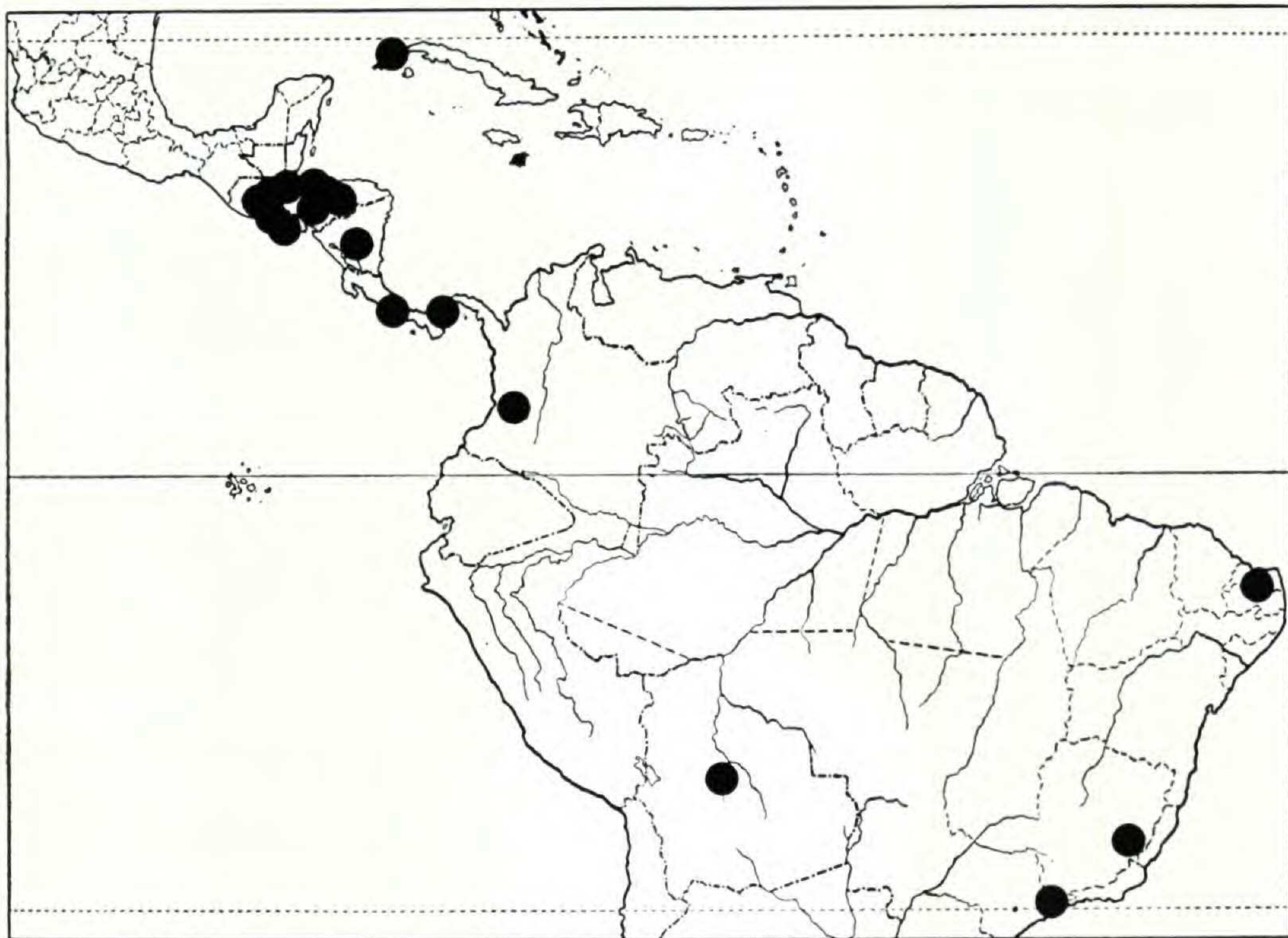
Leaves erect, long-petioled except in individuals from dry soil; blades shallowly cordate, about as wide as long, often very large and reaching 55 cm. in length; pellucid markings usually very clear (Figs. 56–58); inflorescence simple or branching; flowers verticillate on pedicels that may reach 4 cm. in length as the fruits mature; nutlets (Figs. 30–31) winged on the back, with 3 or 4 ribs that are sometimes slightly winged toward the summit, usually 2 facial glands that are elongate and rounded at both ends and are placed well below the summit of the nutlet, and a short stout beak.

VARIETIES OF ECHINODORUS GRANDIFLORUS

- a. Blades of leaves with pellucid dots, short lines very rare or absent, petals white or pink. var. *grandiflorus*.
- a. Blades of leaves with numerous pellucid lines as well as dots.
 - b. Petals yellow; summit of petiole and base of blade with stellate hairs. var. *aureus*.
 - b. Petals white; leaves glabrous. var. *ovatus*.

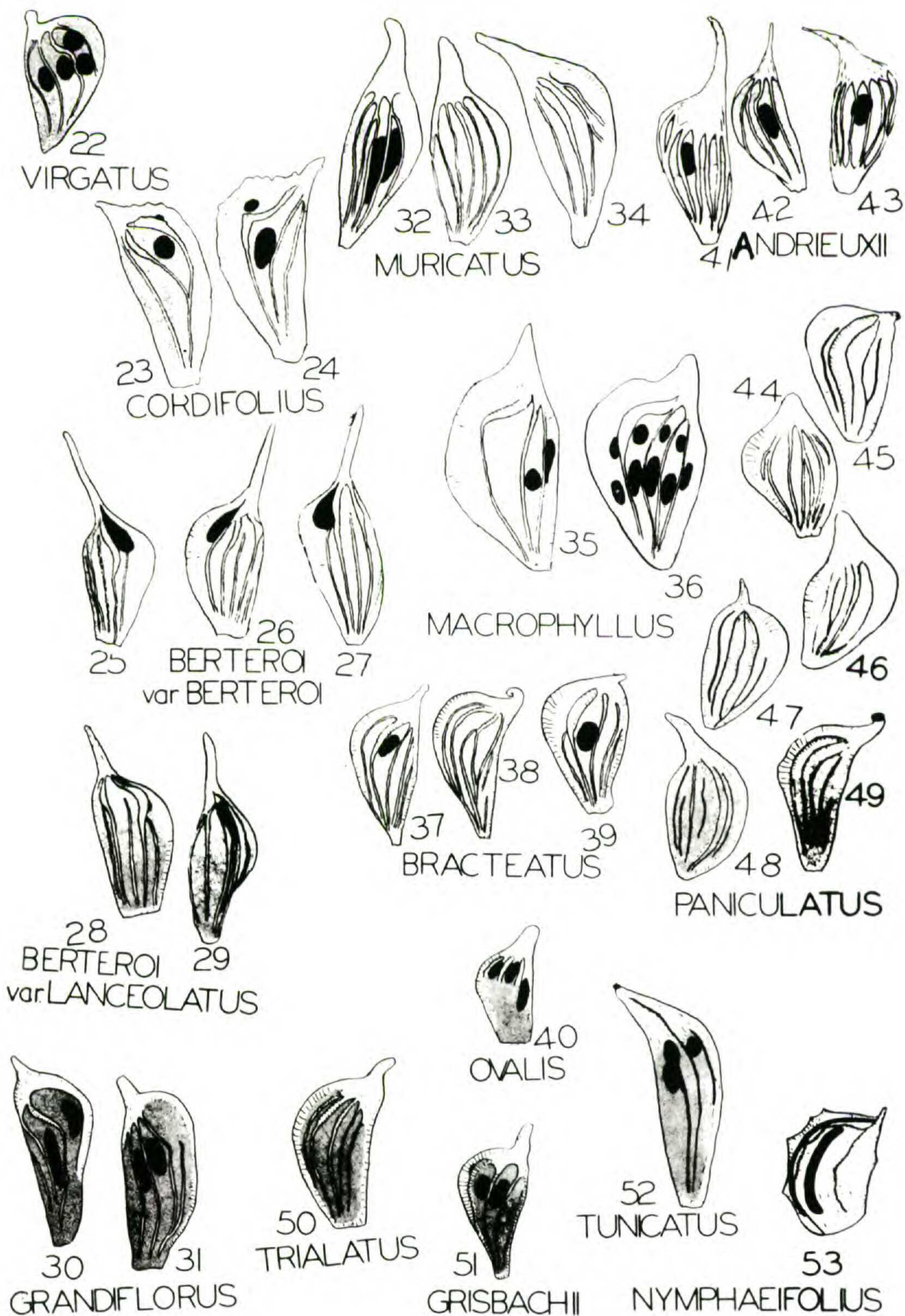
4a. *E. GRANDIFLORUS* (Cham & Schlecht.) Micheli, var. *GRANDIFLORUS*. *Alisma grandiflorum* Cham. & Schlecht., l.c. Leaves with tubercle-based stellate hairs about the summit of the petiole and base of the blade, the hairs sometimes wearing off so that the persistent bases give a muricate appearance; pellucid markings nearly all dots (Fig. 56) with lines very rare or absent; petals white or rarely pink.

Cuba and Guatemala to Paraguay and southern Brazil (Map 3). This range appears to be bicentric, with a long gap between Colombia and Bolivia. I have not found any positive differences between the var. *grandiflorus* of the two parts of the range.



Map 3. *Echinodorus grandiflorus* var. *grandiflorus*.

Cuba: Prov. Pinar del Rio, Arroyo Mantua, S. Francisco ad stagnum, flor. albi, 29 May 1920, *Ekman 10974* (NY). **Guatemala:** Rio de Los Esclavos, Dept. Santa Rosa, August 1892, *Heyde & Lux 4074* (GH, NY, US); vicinity of Quirigua, Dept. Izabal, alt. 75–225 m., 15–31 May 1922, *Standley 23858* (GH, NY, US); in a slough, Quirigua, 17 May 1937, *Muenschner 12065* (F); edge of small stream, herb 1 m. tall, petals white, near El Molino, Dept. Santa Rosa, alt. about 600 m., 26 November 1940, *Standley 78399* (F); Los Amates, Dept. Izabal, alt. 90 m., 20 February 1907, *Kellerman 6615* (F); Lago Retana, between Ovejero and Progreso, alt. 600 m., 26 November 1939, *Steyermarck 31985* (F); in water of swamp, valley of Río Chiquimula, $1\frac{1}{2}$ mi. northeast of Chiquimula, alt. 400 m., 21 October 1939, *Steyermarck 30120* (F). **El Salvador:** edge of river, plants 1 m. high, petals white, vicinity of Ahuachapan, Dept. Ahuachapan, alt. about 700–1100 m., 16–25 January 1947, *Standley & Padilla 2518* (F); herb 3–4 ft., fls. white, open swamp, vicinity of Tepetitán, Dept. San Vicente, alt. about 400 m., 6 March 1922, *Standley 21427* (GH, NY, US); Zacatecoluca, March 1922, *Calderon 301* (GH, NY, US); herb 3–4 ft., fls. white, swamp along river, vicinity of Nahulingo, Dept. Sonsonate, alt. about 220 m., *Standley 22019* (GH, NY, US); herb 3–5 ft., fls. white, in swamp, abundant, vicinity of Ateos, Dept. La Libertad, 17 April 1922, *Standley 23346* (US). **Honduras:** in marsh, acaulescent herb 3–4 ft., inflorescence much branched, vicinity of Tela, Dept. Atlántida, at sea level, 14 December 1927–15 March 1928, *Standley 54522* (F, US); Tela, 1923, *van Severén 38* (US); corolla white, in marsh, near



Tela, 8 September 1934, *Yuncker 4985* (F, MO); fls. blancas, en sabana, margenes del Río Jalán, 3 kms. al norte de Guaimaca, Dept. Morazán, 13 June 1950, *Molina 3065* (F); El Banco, Dept. Comayagua, alt. 640 m., 13 March 1945, *Valerio 2341* (F); in marsh, herb 1 m., petals white, vicinity of Juticalpa, Dept. Olancho, 380–480 m., 5–16 March 1949, *Standley 18057* (F). **Nicaragua:** in ditch, plants 1 m. high, fls. white, vicinity of La Libertad, about 500–700 m., Dept. Chontales, 29 May–1 June 1947, *Standley 8977* (F). **Panamá:** swamp, Boquete, Prov. Chiriqui, 3800 ft., 21 May 1938, *Davidson 691* (F, GH); flowers lavender pink, lower portion of valley and marshes along R. Antón, El Valle de Antón, about 500 m., 2 February 1935, *Hunter & Allen 381* (F, US); inflorescence 1.5–2 m. tall, marshy borders of streams, El Valle de Antón and vicinity, 500–700 m., 23–27 July 1935, *Seibert 490* (GH, MO, NY); flowers white, vicinity of Boquete, alt. 1200–1500 m., 24–26 July 1940, *Woodson & Schery 754* (GH, MO, US); in bog, flowers white, between Las Margaritas and El Valle, 15 July, 8 August 1938, *Woodson, Allen & Seibert 1736* (GH, NY). **Colombia:** loco uliginoso, 1100 m., Timba, Dept. Valle, 3 January 1937, *von Sneider 1135* (NY). **Bolivia:** Buer a Vista, Dept. Santa Cruz, flor. blanca, 29 October 1916, *Steinbach 2868* (F). **Brazil:** perennial herb 1.5 m. high, white flower, road to São Miguel near km. 11, swampy land near corríga, alt. 650 m., State of Minas Geraes, 28 December 1929, *Mexia 4179* (F, GH, MO, PH, US, NY); Cambuquira, 25 December 1935, *Barreto 927* (F); Minas Geraes, 1840, *Claussen*, cited by Micheli as var. *floribundus* (GH); locis paludosis, Pinhaes, Paraná, 885 m., 14 October 1914, *Dusén 1132a* (GH); Blumenau, Sta. Ca'arina, January 1888, *Ule 540*—leaf with pellucid lines and dots of var. *ovatus* but pubescence of var. *grandiflorus* (US); Minas Geraes, 1845, *Widgren* (US); Minas Geraes, 1865, *Regnell 418* (US); Prov. Caera, August–November 1838, *Gardner 1860*, cited by Micheli under var. *floribundus* (NY). **Paraguay:** Pilcomayo River, *Morong 853* (MO, US).

FIG. 22–53. NUTLETS OF SUBGENUS ECHINODORUS ($\times 10$). Fig. 22: *E. virgatus*, Mexico, Beechey (fragment of type, in MO). Fig. 23, 24: *E. cordifolius*. Tennessee, Gattinger 2741 (US). Fig. 25–27. *E. Berteroi* var. *Berteroi*. 25: Curacao, Britton & Shafer 3115 (US). 26: Puerto Rico, Sintenis 3375 (US). 27: Mexico, Pringle 8484 (US). Fig. 28, 29. *E. Berteroi* var. *lanceolatus*. 28: Illinois, Engelmann (type of *E. rostratus* var. *lanceolatus* in MO). 29: Oklahoma, Nuttall (type of *Alisma rostrata*, in PH). Fig. 30, 31. *E. grandiflorus* var. *grandiflorus*. 30: Honduras Standley 53610 (US). 31: Uruguay, Bartlett 2182 (unidentified variety in US). Fig. 32, 33. *E. muricatus*. 32: Brazil, Tate 61 (US). 33: Brazil, Tate 61 (NY). Fig. 34. Unidentified species, perhaps *E. muricatus*, Bolivia, Rusby 1419 (NY). Fig. 35, 36. *E. macrophyllus*, Brazil, Pereira 3602 (US). Fig. 37, 39. *E. bracteatus* var. *bracteatus*, Ecuador, Hitchcock 29984 (NY); fig. 39: var. *efenestratus*, Ecuador, Rimbach 90 (type in F). Fig. 40. *E. ovalis*, Cuba, Wright (immature nutlet in US). Fig. 41–43. *E. Andrieuxii*. 41: Mexico, Rose, Standley & Russell 14100 (NY). 42: Mexico, Mexia 1065 (US). 43: Mexico, Hinton 2667 (US). Fig. 44–49. *E. paniculatus*. 44: Bolivia, Kuntze (NY). 45: Venezuela, Chardon 26 (US). 46: Bolivia, Cárdenas 4466 (US). 47: Venezuela, Fernandez 71 (US). 48: Bolivia, Cárdenas 4466 (US). 49: Ecuador, Hitchcock 20278 (US). Fig. 50. *E. trialatus*, Colombia, Cuatrecasas 4283 (type in US). Fig. 51. *E. Grisebachii*, Cuba, Wright 3198 (US). Fig. 52. *E. tunicatus*, Panama, Maxon 7095 (US). Fig. 53. *E. nymphaeifolius*, Mexico, Mell 2090 (US).

4b. *E. GRANDIFLORUS* (Cham. & Schlecht.) Micheli, var. **aureus**, Fassett, n. var., foliorum laminis punctis pellucidis lineisque brevibus (0.2–0.5 mm. longis) instructis; floribus flavis; fructus ignotus.—Pubescence of leaves as in var. *grandiflorus*; pellucid dots intermixed with lines 0.2–0.5 mm. long; flowers yellow.—**Cuba**: in bog, 2 ft. or more, flowers yellow, near Rincón, Prov. Havana, 20 January 1905, *van Hermann* 540 (TYPE in F; GH, NY). In absence of fruit, the exact relationships of this plant cannot be determined with certainty.

Throughout the northern part of its continental range, *E. grandiflorus* is constant in its diagnostic characters, responding, apparently, only to ecological factors in such features as size of blades and length of petioles. Southward, in southern Brazil, Argentina, Uruguay, and Paraguay, many plants are glabrous, with pellucid lines, mostly 1 mm. or less long, replacing many of the dots in the blades (Fig. 57): they probably represent *E. grandiflorus* var. *ovatus* Micheli in DC., Monogr. Phan. **3**: 58. 1881. In about the same region appear other plants with pedicels up to 4 cm. in length, and pellucid lines to 2 mm. long (Fig. 58), often suggesting those of *E. Berteroi*. Several taxa have been described from the area, including *E. Sellowianus* Buch., Pflanzenr. **4**, fam. 15: 30. 1903, and *E. longiscapus* Arechavaleta, Anal. Mus. Nac. Montevideo **4**, pt. 1: 67, pl. 2. 1903. The treatment of Argentinean Alismataceae by Hauman, Anal. Mus. Nac. Buenos Aires **27**: 311. 1915, appears to have the advantage of being based on familiarity with the plants in the field, but Hauman does not express complete certainty as to the relationships of the species named in this paragraph.

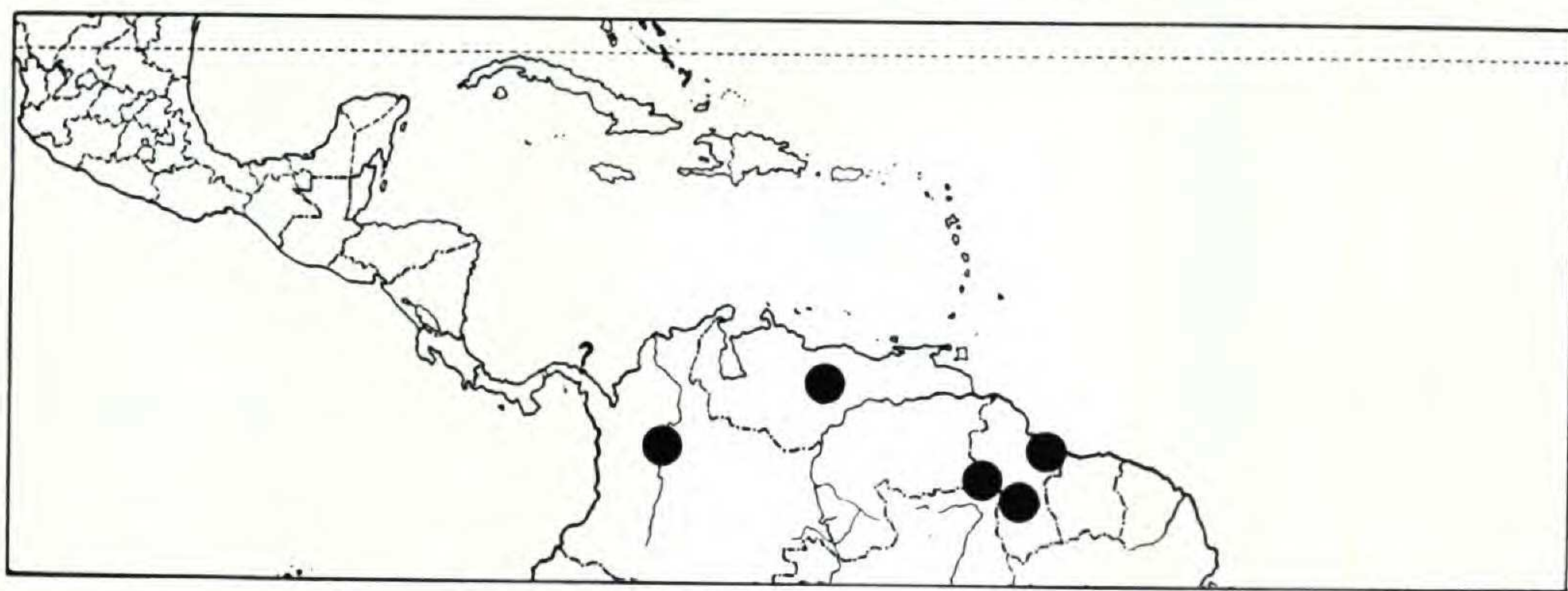
5. *ECHINODORUS MURICATUS* Griseb., Bonplandia **6**: 11. 1858. *E. macrophyllus* β *muricatus* Micheli in DC., Monogr. Phan. **3**: 50. 1881. Not *E. muricatus* Woodson & Schery, Fl. Panama, Ann. Mo. Bot. Gard. **30**: 101. 1943.

Leaves erect, long-petioled, the blades cordate at base, a little longer than wide (Fig. 11), sometimes reaching about 50 cm. in length, without pellucid lines or dots (veins rarely pellucid); pubescence stellate mostly about the summit of petiole and base of blade, often wearing off and leaving papilla-like bases; inflorescence a meter or more high, compound and ample; pedicels 1–3 cm. long, subtended by bracts or sometimes by reduced cordate leaves; fruit with body 2.5–3 mm. long and beak 0.3–1 mm. long, keeled, with 4–5 scarcely winged ribs on each face, mostly with 1–3 glands (Fig. 32) or rarely glandless (Figs. 33–34).

Panama to Ecuador and British Guiana (Map 4). **Colombia**: wet swamp, alt. 130–140 m., Puerto Berrio, Dept. Antioquia, 14 July 1917,

Pennell & Rusby 57 (NY); Puerto Berrio, 11–13 January 1918, *Pennell 3734* (GH, NY). **Venezuela:** La Rubiera cerca de Calabozo, Guarico, 1925, *Grisel 1*—mixed with *E. paniculatus* (NY, US). **British Guiana:** in water, 4 feet high, Limao, Mount Roraima, 21 September 1927, *Tate 61* (NY); Berbice, June 1889, *Jenman 5162* (NY); near Neue Amsterdam, April 1889, *Jenman 5080* (NY).

I have seen no *Echinodorus* with leaves actually muricate, but there are 3 species with stellate hairs that eventually drop off to leave just the tuberculate bases: these are *E. grandiflorus*, *E. bracteatus* and *E. muricatus*. The type of *E. muricatus* is from Panama; I have not seen this type, nor any other material of



Map 4. *Echinodorus muricatus*.

E. muricatus from Panama. But Micheli, who seems to have examined the type, and whose observations concerning pellucid markings appear to be very reliable, lists *E. macrophyllus* β *muricatus* under "Folia punctis lineisve pellucidis destituta," thus excluding the possibility of the type of *E. muricatus* belonging with *E. grandiflorus* or *E. bracteatus*.

E. muricatus was treated by Micheli as a variety of the more southern *E. macrophyllus* (Kunth) Micheli. Both species have leaves without pellucid markings (Fig. 59) but those of *E. macrophyllus* are glabrous. The achene of *Alisma macrophyllum* was described by Kunth (Enum. Pl. 3: 51. 1841) as being 2-ribbed on each side. The only good fruiting material of *E. macrophyllus* available to the writer is *Pereira 3602* from São Paulo (US); it has fruits mostly 3-ribbed (Fig. 35) or 4-ribbed (Fig. 36). This plant also shows variation in the number of glands, not mentioned by Kunth, but given by Micheli as usually 3 or 4.

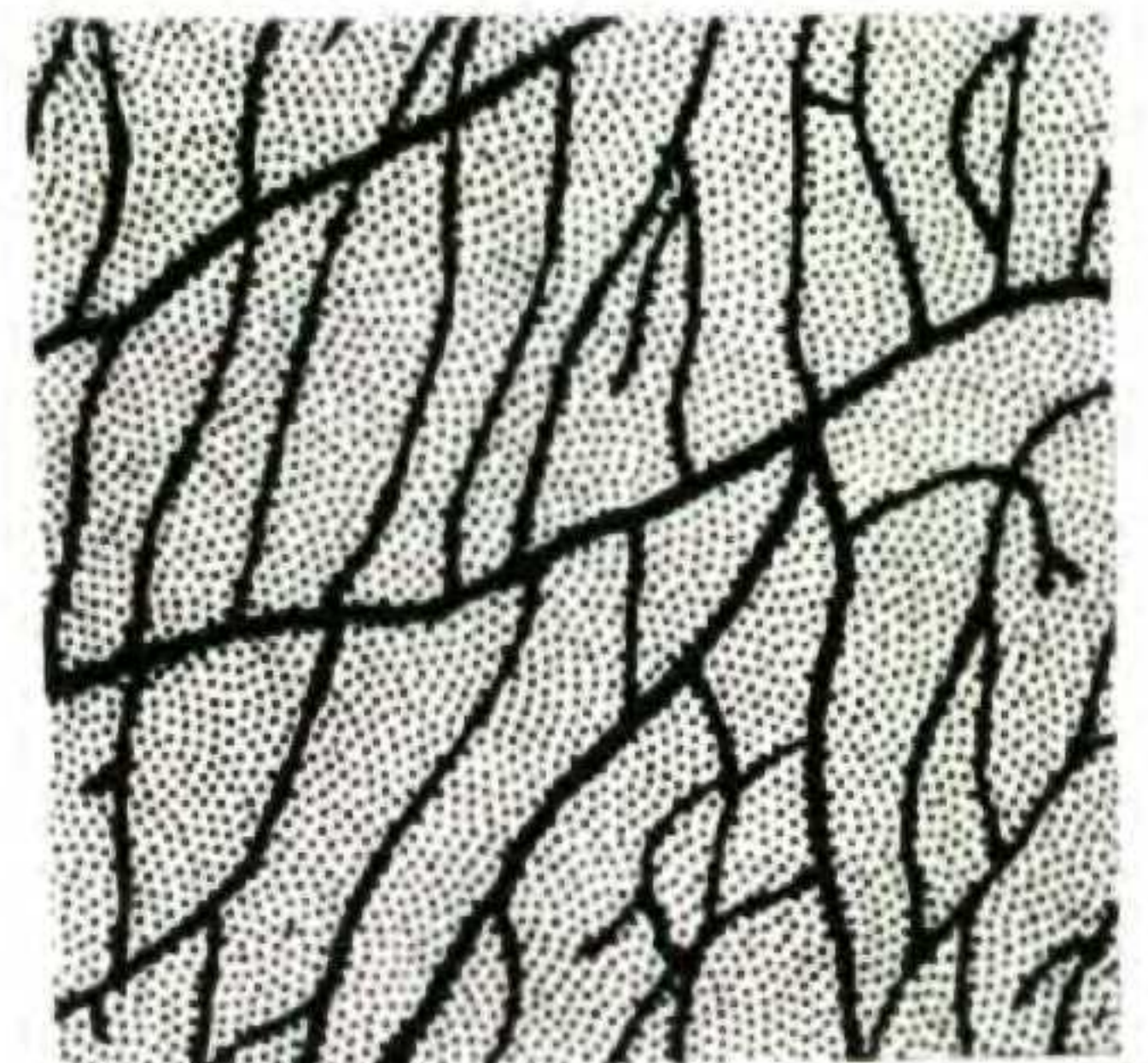
Collections from near Lake Rogagua, Bolivia, *H. H. Rusby 1419* (flowers & fruit—NY) and *1415* (leaves & fruit—NY) are



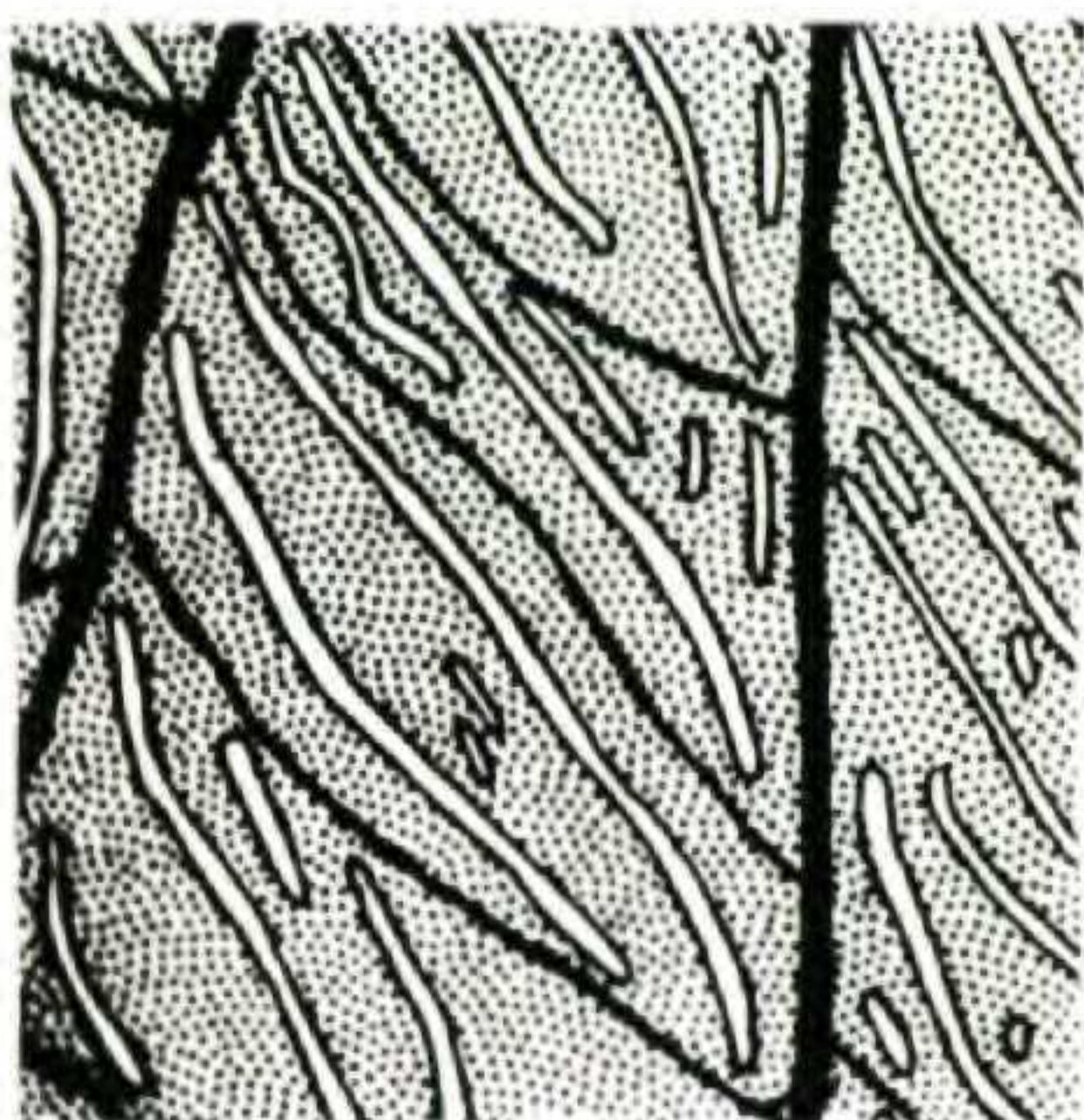
54 CORDIFOLIUS



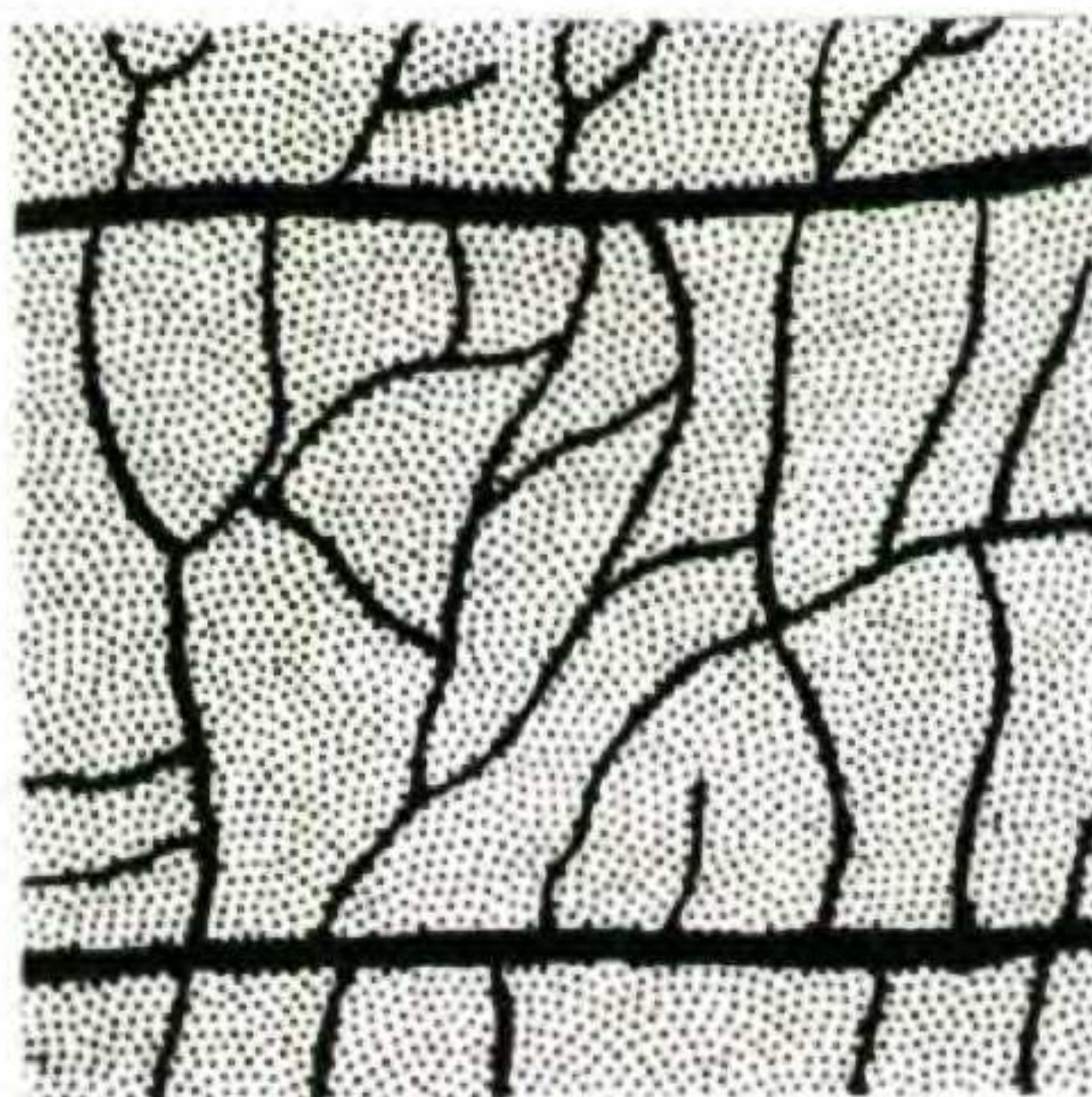
58 GRANDIFLORUS



62 TRIALATUS



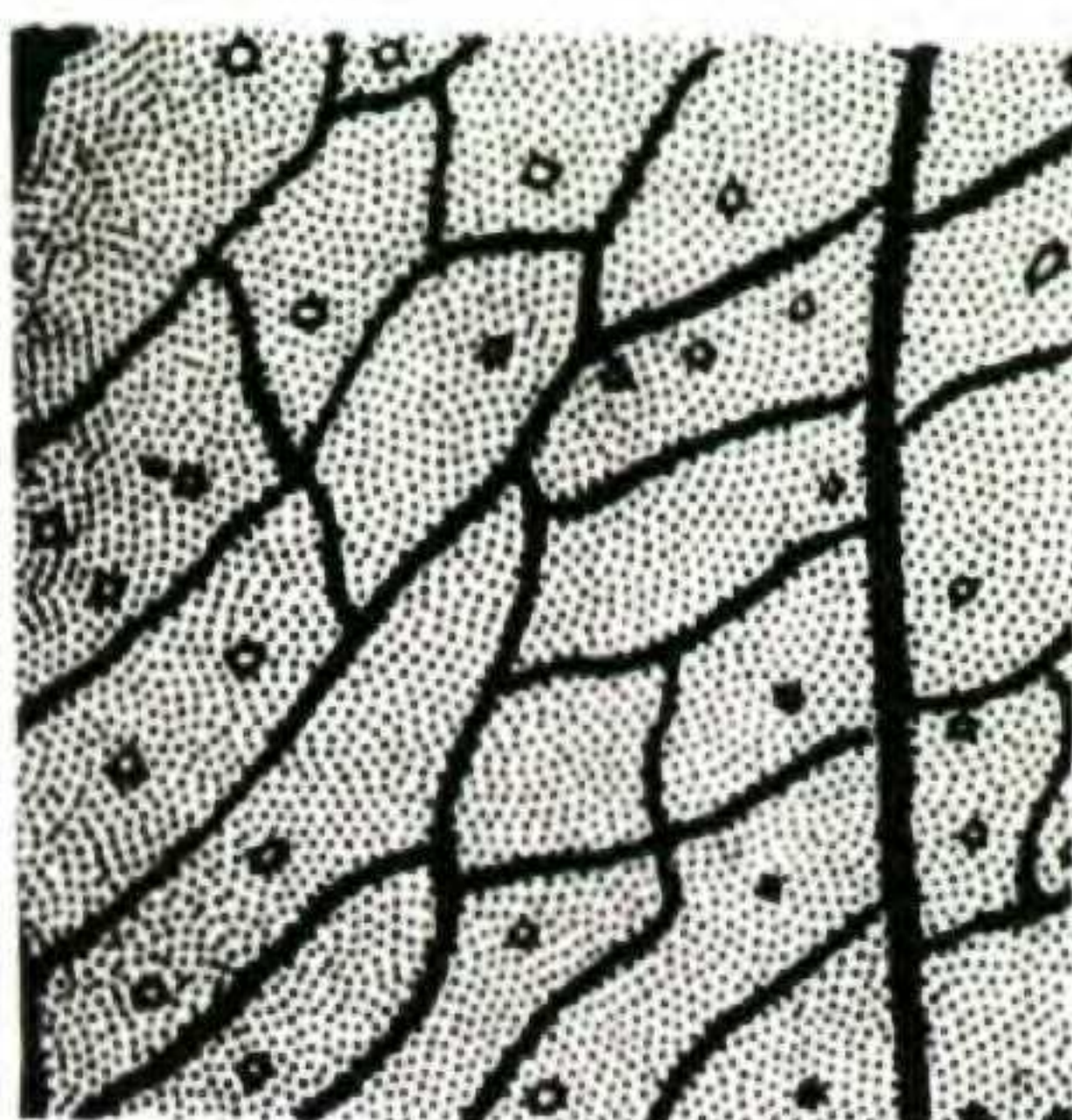
55 BERTEROI



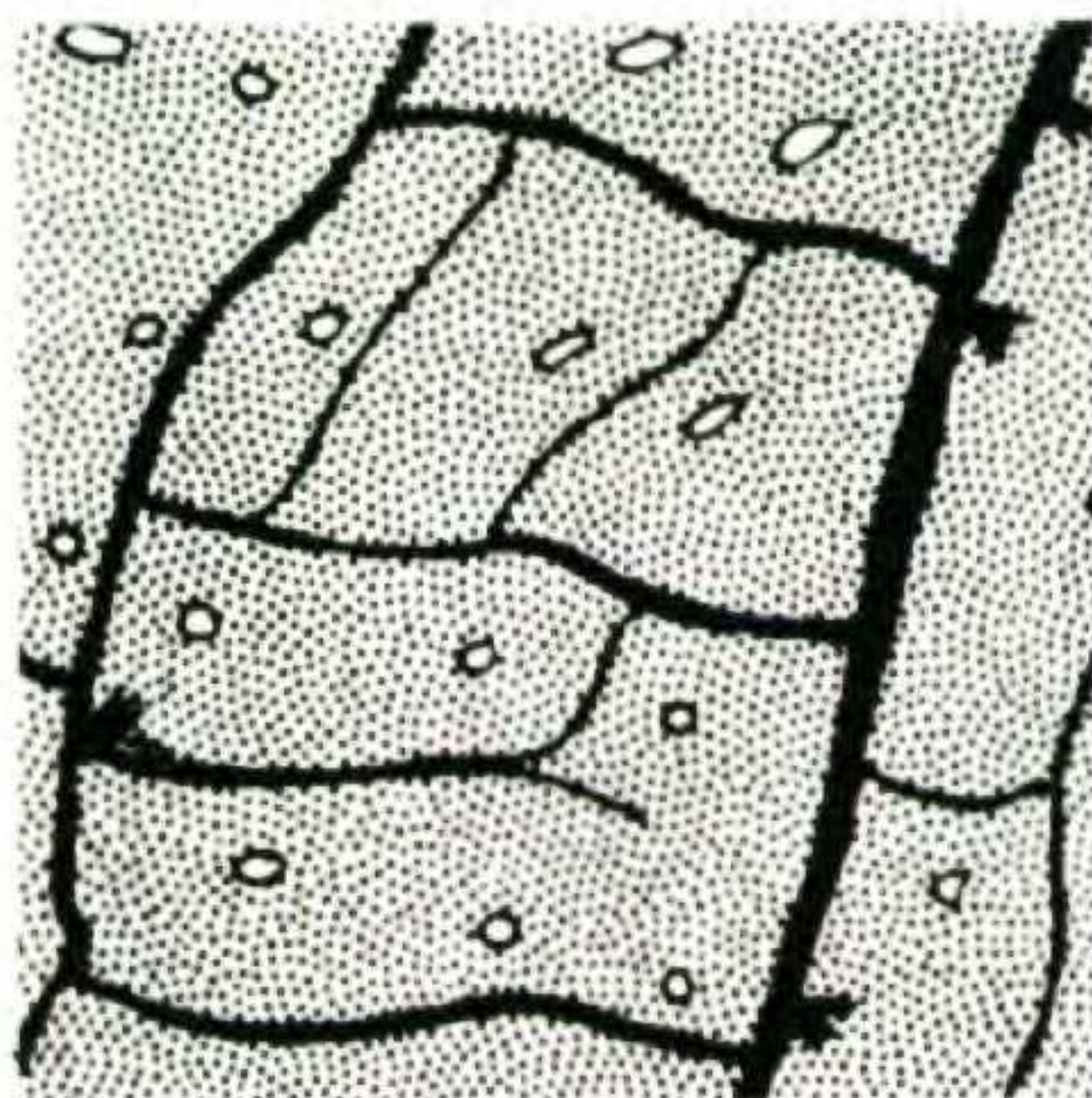
59 MACROPHYLLUS



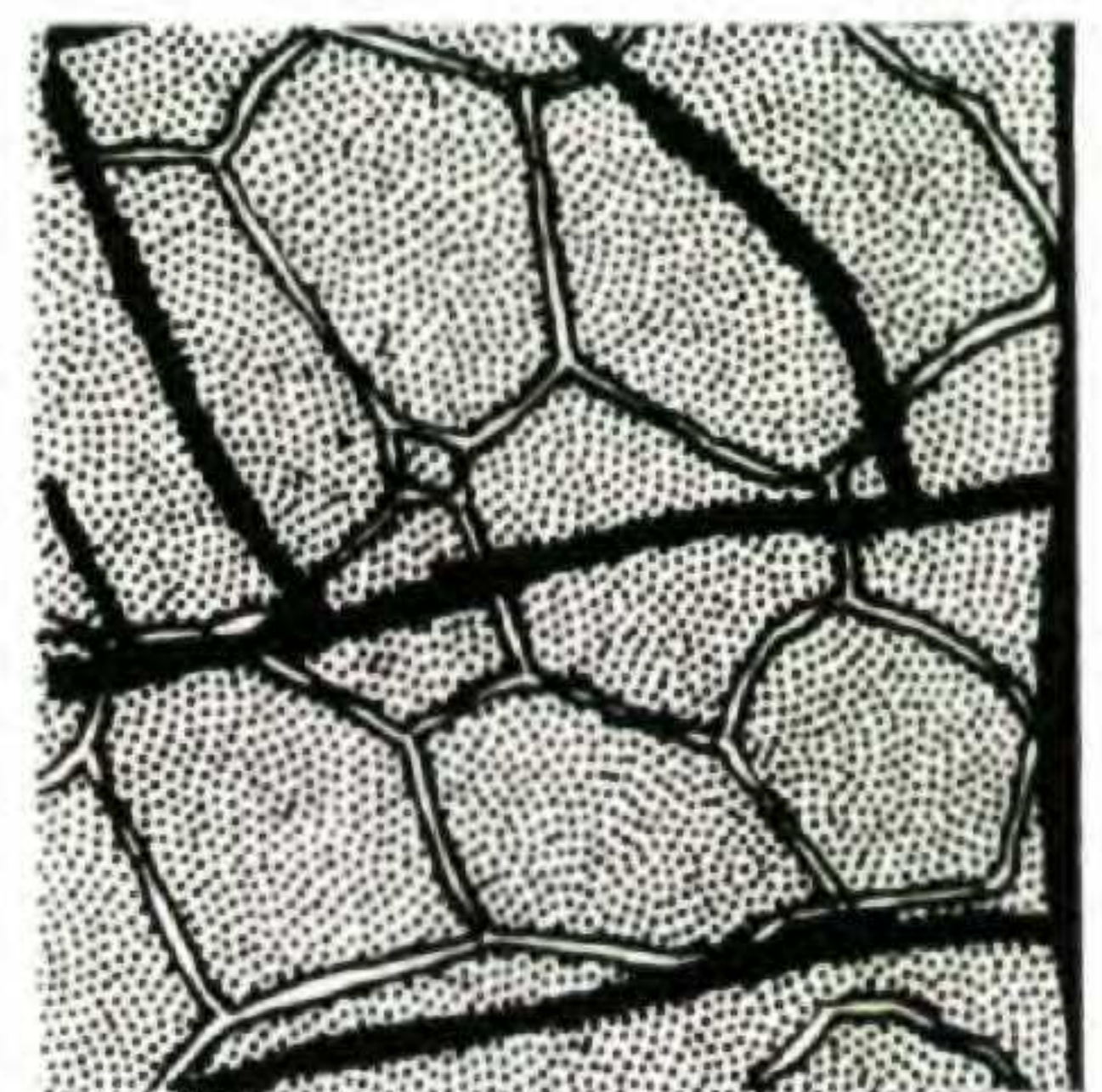
63 GRISBACHII



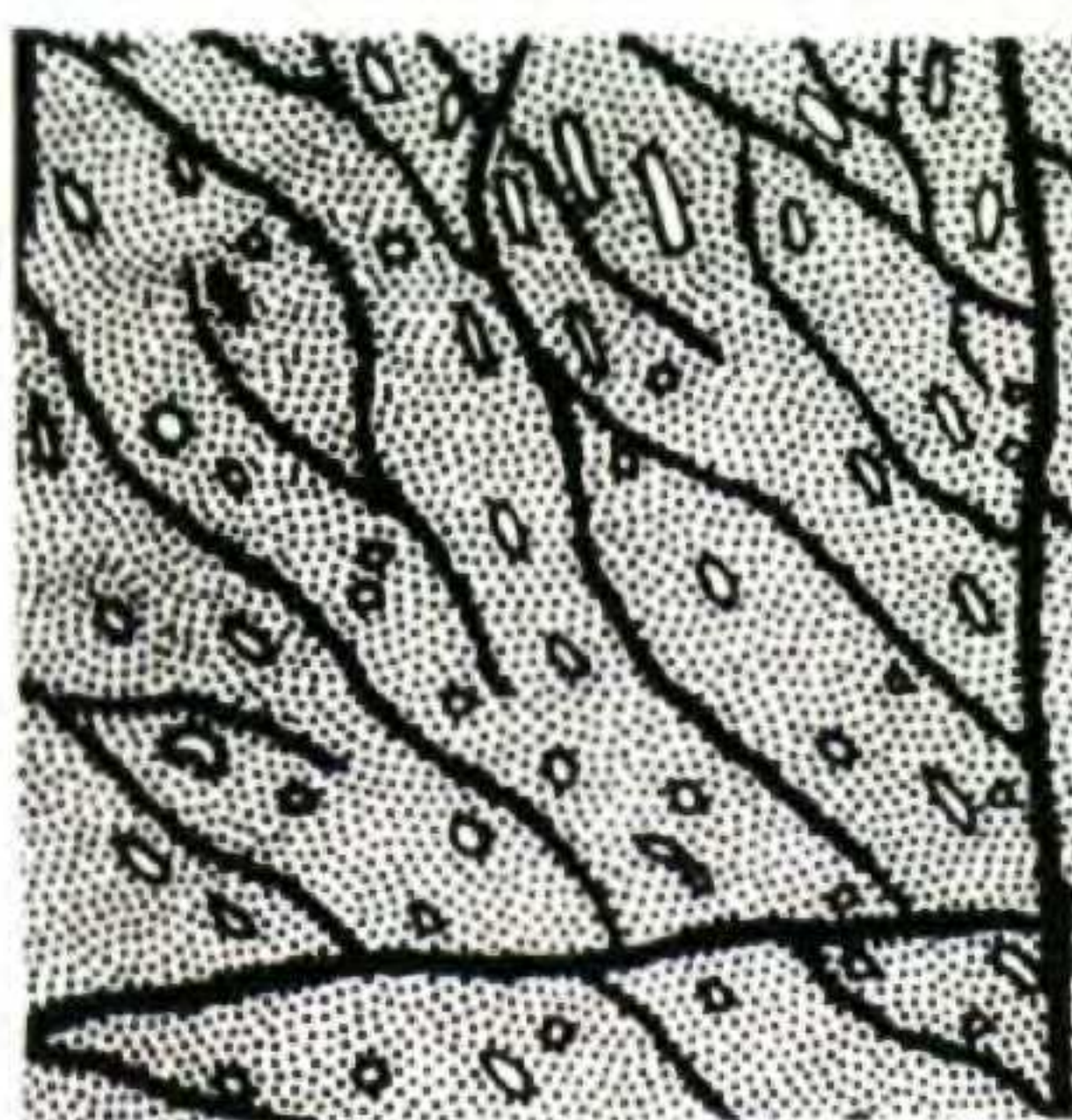
56 GRANDIFLORUS



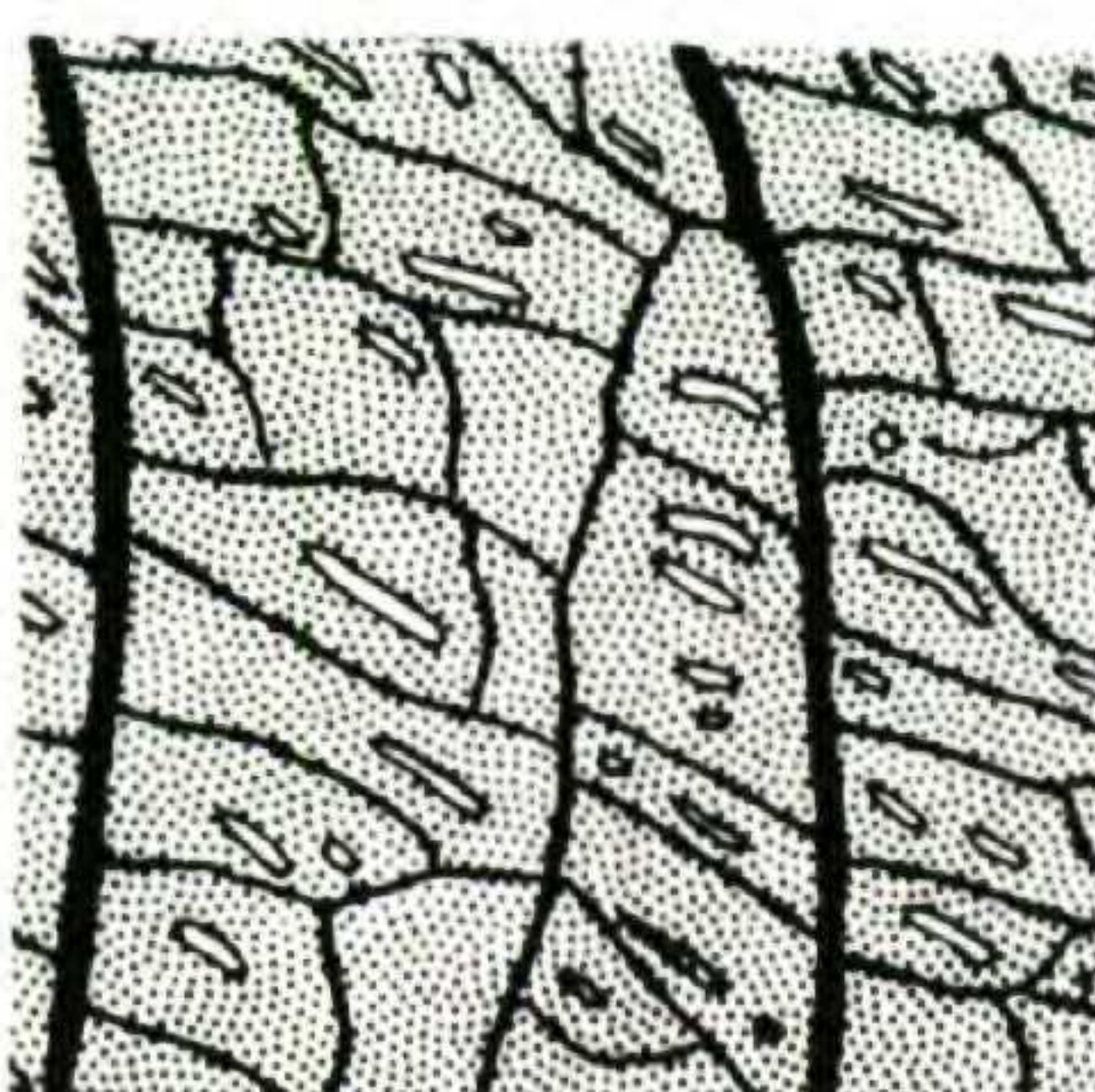
60 BRACTEATUS



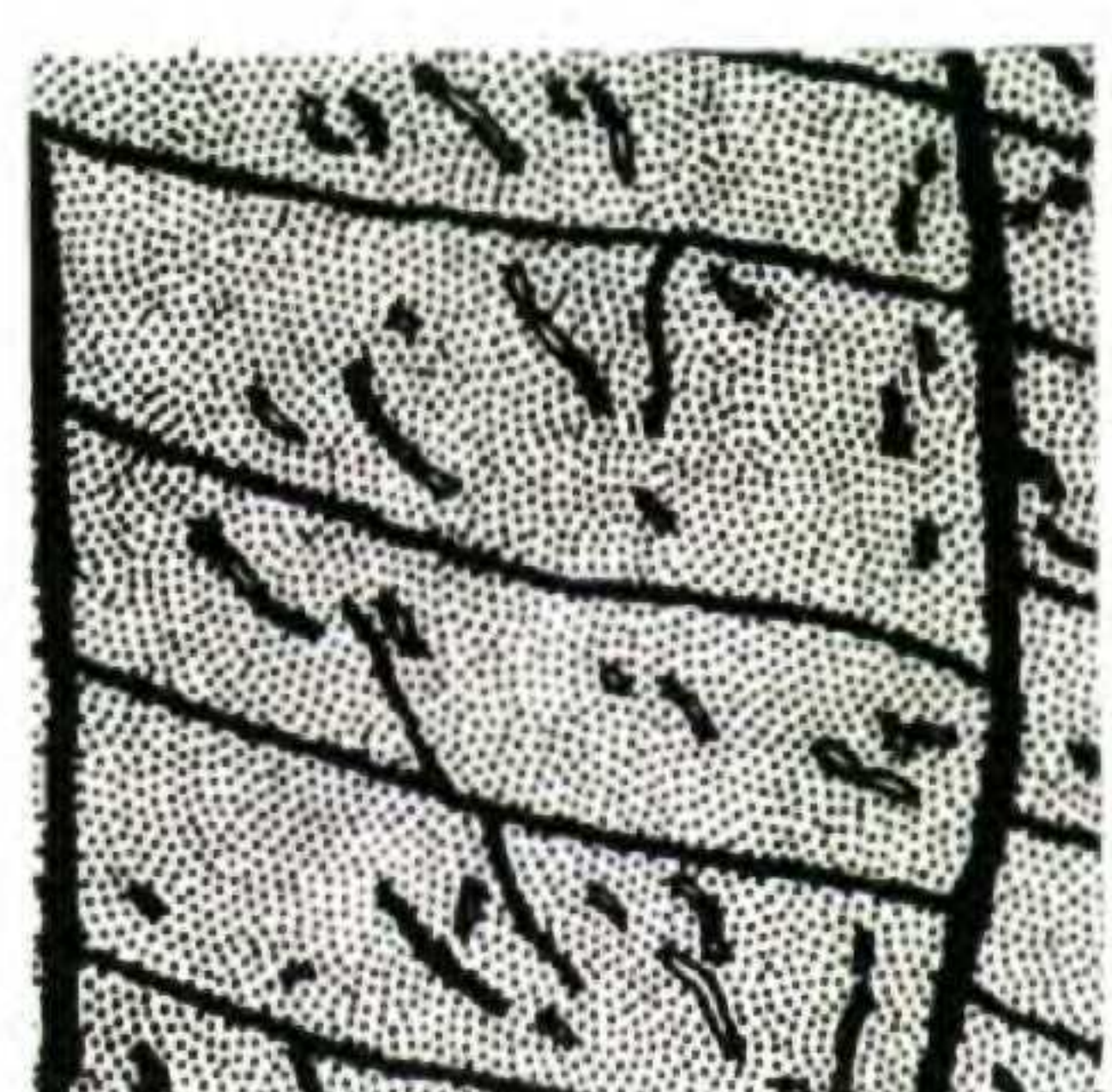
64 TUNCATUS



57 GRANDIFLORUS



61 OVALIS

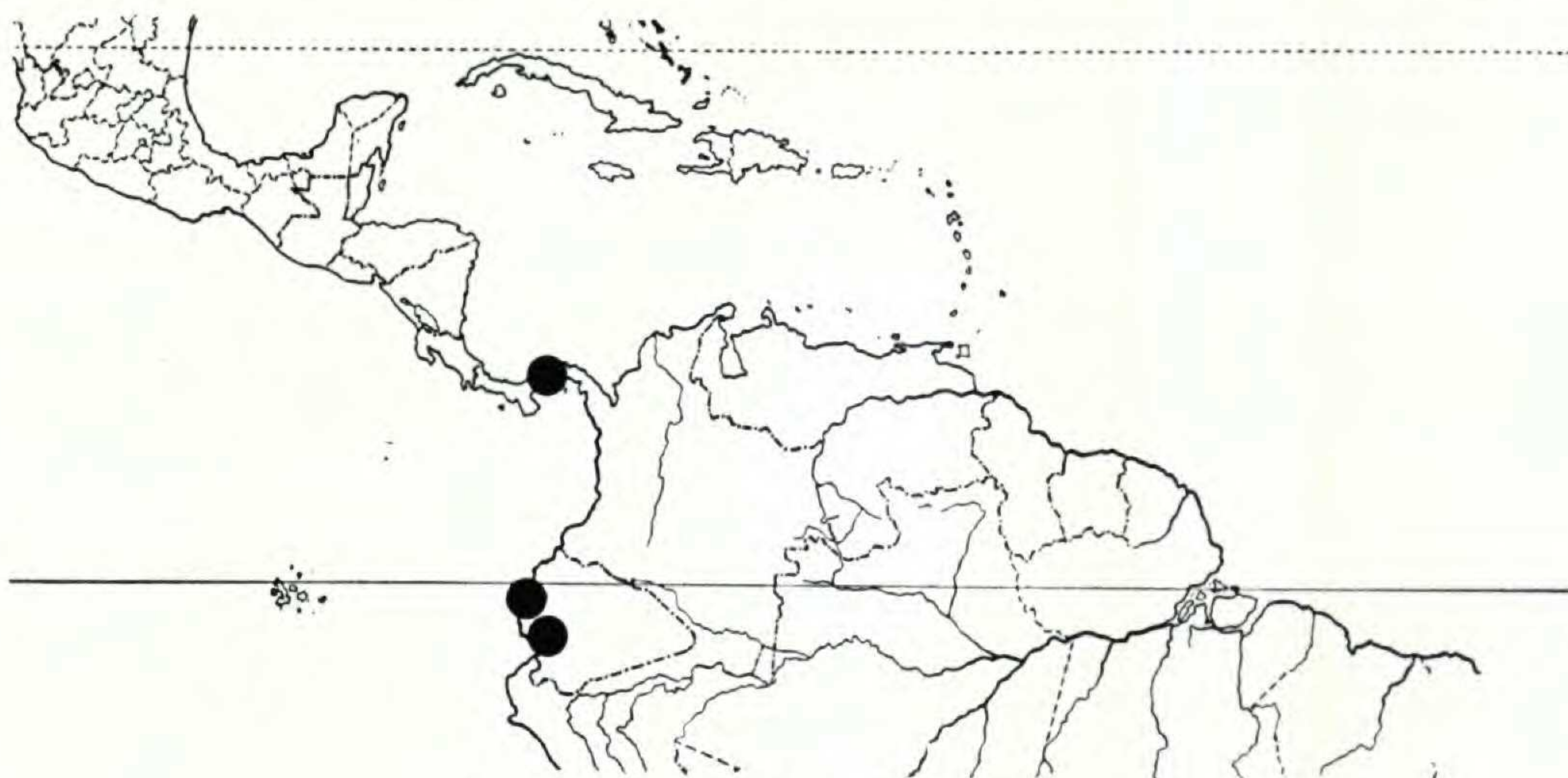


65 NYMPHAEIFOLIUS

FIG. 54-65. PORTIONS OF LEAVES OF SUBGENUS ECHINODORUS, AS SEEN BY TRANSMITTED LIGHT (\times about 7). Fig. 54. *E. cordifolius*. Tennessee, Gattinger 2741 (US). Fig. 55. *E. Berteroi*. Santo Domingo, Eggers 2477 (US). Fig. 56. *E. grandiflorus* var. *grandiflorus*. Honduras, Standley 53610 (US). Fig. 57. *E. grandiflorus* var. *ovatus*. Argentina, Venturi 2416 (US). Fig. 58. *E. grandiflorus*, unidentified variety. Bolivia, Cárdenas 4465 (US). Fig. 59. *E. macrophyllus*, Brazil, Pereira 3602 (US). Fig. 60. *E. bracteatus* var. *bracteatus*, Panama, Standley 26724 (US). Fig. 61. *E. ovalis*, Cuba, Wright, (US). Fig. 62. *E. trialatus*, Colombia, Cuatrecasas 7391 (US). Fig. 63. *E. Grisebachii*, Cuba, Wright 3198 (US). Fig. 64. *E. tunicatus*, Costa Rica, Lankester 947 (US). Fig. 65. *E. nymphaeifolius*, Mexico, Mell 2090 (US).

stellate-pubescent like *E. muricatus* and may be conspecific with it. The nutlets are consistently glandless (Fig. 34) with somewhat branching facial ribs.

6. *ECHINODORUS fluitans* Fassett, n. sp., planta aquatica, foliorum petiolis longis, laminis 14 cm. longis 8 cm. latis, ad apicem obtusis, ad basim cordatis-subtruncatis; petiolis ad apicem et laminis ad basim tuberculosus-muricatis aut cum pilis stellatis; scapis horizontalibus, usque ad 1 m. longis; nodis cum radicibus et circa 5 floribus erectis cum pedicellis 5–8 cm. longis; fructus ignotus.—**Colombia:** aquatic, growing in about



Map 5. *Echinodorus bracteatus*.

30 cm. of water. Flowers white, showy; stem to 2 m. long, bearing several inflorescences at intervals, frequently proliferous from these. In ponds near Riohacha, Dept. Magdalena, 24 November 1944, *Oscar Haught* 4450 (TYPE in US).—Seen only from Colombia.

In habit this most closely resembles *E. cordifolius*, with its clusters of long-pedicelled flowers from a prostrate axis. The leaf, however, is quite different, with blades nearly twice as long as wide, more pointed at apex and less deeply cordate at base, and quite without pellucid markings.

7. *ECHINODORUS BRACTEATUS* Micheli in DC., Monogr. Phan. 3: 59. 1881.

Leaves erect, long-petioled except on plants from drier places, the blades about $\frac{2}{3}$ as broad as long, cordate at base, obtuse at tip, mostly about 30 cm. long but sometimes more than 50 cm. long (Fig. 12); inflorescence branched except in dwarfed plants, sometimes nearly 3 m. tall; scape and branches sharply but narrowly 3-winged; flowers sessile or nearly so, usually slightly exceeded by the narrow long-acuminate bracts; nutlets (Figs. 37–39) rather wide, short-beaked, broadly keeled

on the back, with about 5 facial ribs of which usually one is widened and wing-like toward the summit; facial gland single or absent.

Panama to Ecuador (Map 5).

(To be continued)

TWO NEW CARICES FROM SOUTHEASTERN UNITED STATES

F. J. HERMANN

IN southern and central Florida occurs a perplexing sedge that keys out to Series Fetae of Section Ouales in Mackenzie's monograph (N. Amer. Flora **18**: 118. 1931),—a series with which it really has no close affinity. Actually, in all characteristics except its ovate-orbicular rather than obovate perigynium, it is most closely related to *Carex alata* Torr. & Gray (Series Alatae). But from this species it further differs in lacking aristate or long-acuminate scales, the lower being obtuse and the upper acute to short-acuminate, and in its longer, more slender perigynium beak. The perigynium is usually broadest near the middle (occasionally near the base or top) and is less thin and flat than that of *C. alata*. The shape of the perigynium is more suggestive of that of *C. brevior* (Dewey) Mackenz., but from this it is readily distinguished by the narrower, stipitate achene, the larger perigynium with much larger corky, crescent-shaped areas bordering the achene, and the lack of ventrally hyaline leaf-sheaths. This sedge may be known as:

Carex vexans sp. nov. (Ouales). Caespitosa; culmi folia plus minusve superantes; folia ad basim culmi maxima ex parte aggregata, vaginis non artis, modo sub ore albidis; squamae lanceolatae, obtusae vel acutae vel interdum breviacuminatae; perigynia modice concavo-convexa, crasse membranacea vel subcoriacea, ovato-orbicularia, manifeste spongiosa, in rostrum 1–1.5 mm. longum abrupte contracta; achaenia elliptico-oblonga stipitata.

Cespitose; culms 2.5–7 cm. high, equaling to considerably exceeding the leaves, bluntly triangular, scabrous below the heads, otherwise smooth; sterile shoots conspicuously developed; lowest leaves bladeless; leaves with well-developed blades 2 to 5 to a fertile culm, mostly on the lower half of the culm, the blades flat, linear, 4–15 cm. long, 2.5–4 mm. wide, scabrous on the margins and midrib toward attenuate apex, the sheaths rather loose, white-hyaline only below the mouth, rupturing tardily and not becoming fibrillose, the ligule from slightly longer to twice as long as wide, 2.5–4 mm. long, 2–3 mm. wide, blunt; head oblong to ovoid-oblong, 1.5–3 cm. long, 1–1.5 cm. wide, the spikes 3 to 6, green to glaucous-green, gynaeandrous, aggregated or the